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A CASE STUDY OF ELECTRONIC SIGNATURE APPLIED IN PRE-EMPLOYMENT SCREENING INDUSTRY

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Abstract: This paper describes a real case study of how electronic signature technology can be applied to job application and applicant's background screening process. The case study looks at a Knowledge Transfer Partnership (KTP) project between Powerchex Ltd, a pre-employment screening company and the University of East London's School of Computing, Information Technology and Engineering (CITE). The performance is compared with the traditional wet signature process in Powerchex, a pre-employment screening company based in London. Experiments show efficiency is significantly improved in Powerchex, in terms of faster turn around and reference request time. Other benefits include improved customer satisfaction and system usability. The paper also looks at secure implementations that have been used to protect the signature information.

1. Introduction:

This paper looks at a Knowledge Transfer Partnerships (KTP) project between Powerchex Ltd, a pre-employment screening company and the University of East London (UEL)'s School of Computing, Information Technology and Engineering (CITE).

KTP is a UK-wide programme, funded by the Technology Strategy Board with 17 other funding organisations (Research Councils, RDAs, DAs, OGDs), enabling businesses to improve their competitiveness, productivity and performance [1] through a partnership with access to skills and expertise from an academic institution (e.g. university).

Powerchex is a company which specialises in pre-employment screening services for the UK financial services sector. The company's Unique Selling Point is based on a novel, labour-intensive, distributed screening-process reducing turnaround time of the pre-employment screening service from 20 business days, provided by competitors, to 5 business days.

Clients send details of job applicants to Powerchex who then perform a number of pre-employment screenings, ranging from full background checks to individual checks such as credit search, criminal record search, address verification and academic and professional qualification verification. The service price is subject to the type of screening service chosen by the clients, which can also include international checks.

UEL's School of Computing, Information Technology and Engineering (CITE, UEL) offers the top resources in software development and information security area. The professional experts in these areas have solid knowledge to help the project to consider security issues from the early stages of the development process of a software system and therefore better analyse its security requirements and design a solution to satisfy these.

The partnership between Powerchex and UEL is to help the company to develop a customised, secure and automated IT infrastructure, which will enable the company to continue its exponential growth and attract large corporate customers.

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This paper firstly looks at problems caused by the current paper-based system in Powerchex and potential solutions and opportunities the partnership can bring to the company.

Particularly, this paper looks at an innovative electronic signature system which has been introduced to Powerchex's online system. This web-based electronic signature tool replaced Powerchex's wet signature process and allows job applicants to sign a completed online form and give immediate consent to Powerchex who will perform background screening. Performances are compared with the traditional wet signature process and benefits to the company are reviewed. Relevant issues and security implementations are also investigated. A conclusion and future work are presented in the end of this paper.

2. Background:

2.1. Powerchex's Paper Based System:

Powerchex is an award wining; London based pre-employment screening company which provides customised services specifically to the financial services market.

The existing system in Powerchex is paper-based. The following problems were identified during the system analysis of this project:

- Labour intensive and prone to errors, costly and not readily scaleable and therefore lacking the capacity to deal with the volume of work from major banks (i.e. the target market).
- Not secure enough; the financial sector deals with large amounts of sensitive and private data and therefore security is the number one concern for major banks;

Specifically, the paper based online system is extremely inefficient both for the job applicants and Powerchex officers, in terms of delay in turnaround time for chasing applicant's consent. The job applicant needs to manually sign the consent form which gives screening authorisation to Powerchex. Powerchex vet applicants on behalf of its clients. The signed consent forms give Powerchex the permission to carry out background checks on behalf of the applicant. And copies of the signed declaration will be sent to previous employers/academic institutions to provide them with consent from the applicant to carry out checks. Powerchex cannot, and do not, conduct any checks on the applicant unless they have signed the consent form.

However, a large number of applicants who managed to complete the form but forget to send or don't have access to a scanner or fax machine to send across their consent forms to Powerchex.

One of the most important unique selling points for Powerchex is its quick turnaround time (5- 10 days per vet). However, chasing a candidate's signature has severely delayed its service and become a big problem in Powerchex. A new area of looking at replacing the paper consent form with an online electronic (wet) signature equivalent can be therefore investigated. A successful delivery of this "electronic signature tool" will give Powerchex sufficient time for screening, save officers time from chasing with candidates and also provide clients with the quickest service in the country.

2.2. Electronic Signature History:

Electronic signature scheme notion was introduced by Whitfield Diffie and Martin Hellman since 1976 [2]. However, they only assumed that such schemes existed. Later on, RSA [3] (Rivest, Shamir and Adleman) was invented which is an algorithm for public-key cryptography. The RSA is widely

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applied in e-commerce nowadays for signing and encrypting documents.

Other types of electronic signatures have been developed including tick boxes, Adobe Acrobat Self-Sign plug-in, uploading a signature image. However these still have not become popular due to the lack of technology with verification tools. An important feature of paper based signatures is that they can be individually studied and analysed by handwriting experts, by comparing with other existing samples for authentication. And this is the most significant challenge for authenticating electronic signatures.

2.2. Different Types of Electronic Signatures:

Most commonly, an agreement tick box is used to make sure users have read and agreed to all terms and conditions. This is a simple contribution that creates a tick box on the electronic form which the user must check to indicate that they agree to the term and conditions, or other declaration or data protection policy. As shown in figure 1:

☐ I certify I am the person identified

above, and I understand that click

"I Accept" below constitutes my

consent to the agreement above

Figure 1. Electronic agreement tick box
Adobe Acrobat has also developed Self-Sign plug-in which allows user to create an appearance (e.g. figure 2) when they sign a PDF file, including both signing and validation features.
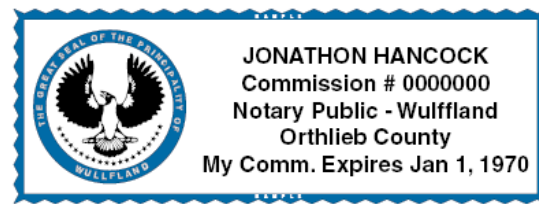

Figure 2. Adobe Acrobat Self-sign Signature
It also allows user to upload a scanned signature image to their PDF files (figure 3).

Figure 3. Adobe Acrobat Self Scanned Signature Image Uploaded to PDF Files
Alternatively, some e-commerce websites allow users to upload their scanned signature images as an agreement to all terms and conditions (figure 4).

Figure 4. Upload Signature Image

3. Electronic Signature Tool:

Electronic signatures are equivalent to traditional handwritten signatures in many respects: signed by the author, used as an authorisation. It has the advantages of inexpensive, effective for users.

3.1. Feasibility Study:

As described in 2.2, the popular types of electronic signature in the market include "terms and conditions agreement tick box", self-sign PDF file and attach signature as image file.

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The "terms and conditions agreement tick box" is cheap, easy to implement and safe to maintain. However, it is difficult for Powerchex to present it as a signed authorisation form, in order to obtain references. This is because the majority referees/companies/schools will request a wet signature as their record, before being able to process the external requests.

The self-sign PDF is a secure way to allow job applicants to sign the form. However, it is more suitable for an internal office environment where all computers have installed the Adobe Acrobat and this plug-in and all staff has been given instructions of how to use it. It is not flexible and realistic to expect all job applicants have Adobe Acrobat installed in their computers and have the knowledge to install this plug-in to the software.

Uploading a signature image to the completed form is easy to use for the job applicants. However, in consideration of the availability of tools (e.g. scanner, digital camera) an applicant may need to use to make a digital copy of the signature, it becomes extremely inconvenient for those who do not have access to a suitable tool. On the other hand, the security implementation to the online system will become more expensive, in order to protect the system from being abused from malicious users, to gain access, or to compromise the server.

In summary of all above, the signing tool therefore must be flexible, available to all job candidates and it must be safe to the system. For this reason, signature pad, using scanner to scan or using a camera to produce a digital copy of the signature can also be excluded.

A computer mouse is easy and convenient to use for all applicants. As the user must have one in hand to be able to use the online system and complete the online form.

Therefore ideally, the electronic signature tool should be designed to save the signature image by capturing the movements of a user's mouse.

3.2. Functionalities Requirements:

Having looked at all the possible solutions of this electronic signature tool, a web-based signature canvas, signing with a computer mouse, is selected to be built for this project. The tool should allow users to sign the online form electronically using their mouse. It should have "Undo", "Redo" and "Clear" functions to allow users to practice and refine the signed image. A brief and vivid instruction of how to sign properly would be ideal for less technical users.

As the main purpose of this signature tool is to obtain applicant's authorised signature image under declaration sections, the tool should be able to extract the signed image to an appropriate size and embed it into applicant's completed form.

3.3. Security Implementation:

The online system should employ encryptions to protect applicant's secure information. For data sent through an internet, a properly implemented system should make the receiver (job applicant) believe that the transaction is encrypted and the organisation (Powerchex) has been authenticated according to the most rigorous industry standard. Therefore, a "128-bit Extended Validation SSL" certificate is installed in the system's website from VeriSign [4] to make sure the transaction is safe and encrypted for users.

Before leaving a job applicant's computer, the signed image is extracted from the web canvas and encrypted using the Base64 encoding schemes [5]. The scheme will convert binary image data in an ASCII string format into a radix-64 representation.

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It ensures that the data remains intact without modification during transport.

In addition to all the above security implementations, before transferring applicant's data to Powerchex's data centre, a server side script algorithm is also developed to encrypt the data using a secret key. The data can only be decrypted in Powerchex data centre using a key.

In order to evaluate the security of the project website, a third party company was hired to perform a penetration test [6] by simulating attacks from malicious sources. The penetration tester performed an automated security scanning for the website, followed by manual tests and research to identify vulnerabilities in the platform. The system has successfully managed to defend and protect itself from being attacked.

3.4. Software Implementation:

The signature tool is implemented with a signing area/canvas where user can move the mouse to sign (as in figure 5).

Figure 5. Signing area/canvas on the tool

Instruction is given as a tooltip for users who are less technical or having no idea on how to use the tool (as shown in figure 6):

Figure 6. Instruction to sign on the tool

The tool also allows user to undo (figure 7), redo (figure 8) a step or to clear (figure 9) the whole canvas when attempting practicing with the new way to sign:
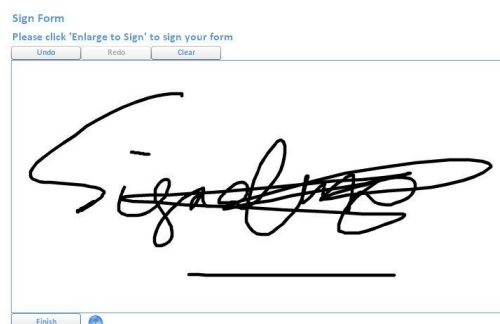
Figure 7. Undo a step

Figure 8. Redo a step

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Figure 9. Clear all

To produce a more sensible image, a couple of criteria are set to makes sure the signed signature is valid to use. In other words, it cannot be empty (as shown in figure 10), and there are at least one single painting's width or height > 20 pixels (e.g. in figure 11).

Figure 10. The canvas cannot be empty

Figure 11. At least one painting's width or height must contain more than 20 pixels

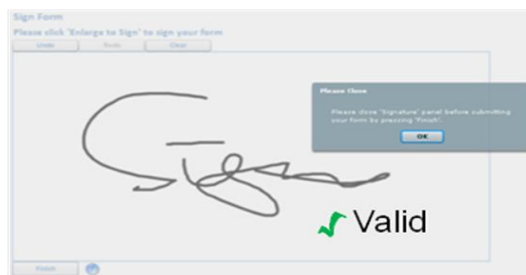Figure 12 is a valid signature which captures a similar one as user's real handwriting signature.

Figure 12. A valid signed signature

3.5. System Integration:

As soon as the applicant submits an online application form, the signed signature image is then embedded into the completed online application form which will be encrypted and saved in Powerchex's secure server, as shown in figure 13.
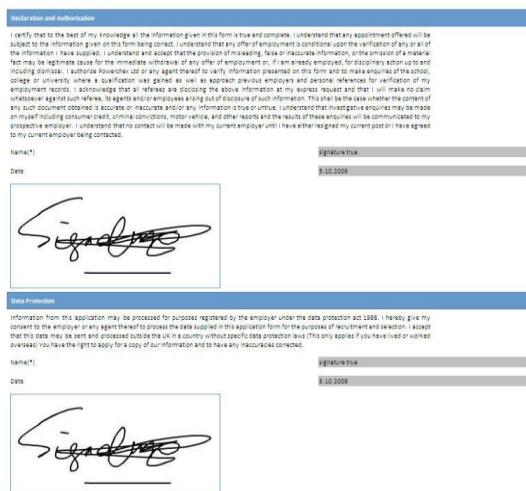

Figure 13. Completed consent form

Figure 13 is a typical example which Powerchex will present to the referees in order to obtain and complete the verification.

3.6. Other Components of the Project:

Apart from the signature tool, there are also other automated processes implemented in the project to help improving Powerchex's

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screening process efficiency. This includes an online application system, an automated checking process and an automated screening report in MS Word format.

The manual verification process used to be applied and completed online by Powerchex's officers. Officers also need to manually extract useful information from job applicants and type into Powerchex's final product – the screening report. Both processes duplicate the information obtained from job applicants. The new processes complete the verification automatically by retrieving required information from applicant's online form. And the screening report are also created automatically without involving any labour work.

4. Results:

The automated online system has implemented faster and efficient screening process, with fewer errors for Powerchex. The innovative implementations including the electronic signature tool, automated process and other secure features have allowed Powerchex to stand out in the market and win the business of the top retail banks.

Specifically, this innovative electronic signature technology has not only helped the company improve its efficiency, but also helped the company to enhance its business image, by introducing new, innovative and unique feature and selling point. Powerchex officers no longer need to chase the job applicants' signatures if they applied online. This saves officers 1-2 days in average per applicant as this process used to be delayed if the signature authorisation is not obtained from the applicants. It therefore enables the company to offer a better screening service with fast turnaround time.

The whole project has helped Powerchex to be capable of serving higher volume of clients from 400 to 1,000 job applicants per month, and therefore doubled the sales of its services.

5. Conclusion:

This paper firstly looks at problems caused in Powerchex by using a paper-based system and, the solutions that this KTP partnership will bring to the company, especially an online system combined with a new electronic signature tool.

The innovative features of this project has helped the company winning the business of major clients (banks), by reducing the number of process errors that it used to encounter, reducing the cost of operation, enlarging the number of screening applications that they could handle, and securing their process and system. It also enabled the company to strengthen their marketing strategy and attract new business.

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