Identifying Interface Design Patterns by Studying Intrinsic Designs

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ABSTRACT

Designing an effective user interface for a new system is challenging even for the most experienced designer. In this study, we present a strategy to find a user interface design pattern for various problem domains through a systematic process. Our strategy arises from studying and analyzing several popular human-centered interface designs in their entirety of evolution. We apply our technique to redesign Walmart’s online-store checkout web-forms, reduce their complexity by almost 80 percent, and greatly improve its performance without compromising its functionality.

KEYWORDS

Interface design, user interface, design pattern, digital interface.

1 INTRODUCTION

User Interface (UI) design has traditionally been the most important factor for designing applications from analog systems to digital systems. An interface of a system is the primary means for the user to interact with the system; and it is the gateway where engineers can hide the details and complexity of the system infrastructure and still provide the users with most, or all, functionalities the system is capable of. The user interface of a system is a great way to allow the user to abstractly see the system as a much simpler model.

In reality, the interface designers give users a wide range of experiences from intuitive and productive to cumbersome and wasteful. However, to design a successful user interface – defined as a simple, intuitive, and to effectively allow the users to complete their tasks with minimal interactions - is a great challenge. “Show everything at once, and the result is chaos. Don’t show everything, and then stuff gets lost” [1]. And “the best interface is no interface” [2], i.e. the system is ubiquitous and capable of recognizing the users’ intentions with precision. Most systems are designed to solve common problems, and almost always there is an interface for a similar system in the same problem domain. There are very few new or emerging systems that need a completely new user interface design. In this study, we analyze many popular interface designs across domains to recognize patterns for successful user interface designs. We also illustrate our methodology to design the next generation interfaces for the smart thermostat NEST, chip-equipped credit cards, and Walmart’s online checkout forms, the world’s largest retailer.

2 QUALITATIVE MEASUREMENT

The popularity of a user interface of a system or product is largely dependent on how the system or product is introduced to the world. That involves the marketing strategy, the brand recognition, the organization fan-base, etc. Thus, the popularity or success of a product may or may not implicate that there is a direct relationship between the user experience with the product interface and the success of the product. For example, IBM [3] in 1992 introduced a touch-screen smartphone named Simon with very limited success (50,000 unit sold), and there are many other companies such as Palm, Qualcomm, Éricson, Nokia etc. that
faced similar outcomes; however, Apple, Inc. introduced iPhone with a multi-touch interface in 2007 with an ongoing success, which is largely contributed to iPhone’s intuitive user interface [4].

Traditionally, interface designs should be tested vigorously starting with informal testing and evaluation tests to recognize, prioritize, and elaborate the user’s “wants” to “needs”. All interface designs need expert-reviews through heuristic evaluations that focus on (1) established heuristics such as Nielsen’s 10 usability heuristics[4], or Shneiderman’s 8 golden rules[5] or Tognazzinis’s first principles, etc., (2) guideline review that checks a design against established guideline documents, (3) consistency inspection that focuses on consistency at various levels from the component level through the system level, (4) cognitive walkthrough that focuses on user- and task-oriented scenarios where experts go through typical user tasks, (5) and formal usability tests and inspections where the experts evaluate and justify piecemeal designs through various user tests to identify fatal design flaws.

There are so many well-known strategies and methodologies for designing and developing an effective user interface, especially those modern methodologies that employ context into their designs as seen in [6] and [7], however, there are so many existing systems with not so great interface designs built by great designers of many world leading organizations and businesses.

Thus, in this study, we define a successful interface design as an interface design that is intuitive and directly allows the user to complete their tasks effectively with minimal learning curve and operational steps. Our measurement is based on the actual tasks to be completed, the classical solution, the minimal operational steps, and the actual interface.

3 CASE STUDY

Since our goal is to identify a successful user interface design, our approach will be in the opposite direction of the traditional approach. We examine existing designs and trace along their evolution path to identify which functionalities and features have survived and/or reoccurred in popular existing designs. What we found may not be a design pattern for a specific problem but rather a pattern to design a user interface that will likely be accepted by its users in the domain of that problem. We have analyzed dozens of systems; however, we limit our scope to only 6 groups of user interface designs for 6 domains of popular problems.

3.1 Telephone Systems

Direct voice communication has been a part of human nature, even before the invention and patent of the telephone in 1876 by Alexander Graham Bell [8]. The most intrinsic communicating method has been exchanging information vocally. It has been done continually for thousands of years. We can clearly observe this technique in a crowd gathering in a busy shopping mall, outdoor concert, or sport event, where two or more people who know each other may call a name out-loud to get the attention of each other and then start talking softer when the involving parties are aware of each other. Strangers may communicate with each other in exactly the same way; where a person may call on another and use surrounding objects to get the other’s attention such as “the lady in pink standing on the left of the podium next to the clown carrying red balloons” or scream “Hey Joe” and jumping up and down waving their hands to get the other party’s attention. In a more formal environment as in a train, bus, or in a conference, one may ask the nearby person to get the attention of another such as “I want to talk to the gentlemen in white suit, can you get him for me please”, and the message will be relayed to other persons closer to the other party until it reaches the intended individual.
The fundamental idea is that one party knows who he/she wants to communicate with and he/she relies on the voice, personal information and/or surrounding context to initiate the communication. Using one’s vocal and hearing capability is intrinsic to human. The original design of the telephone system closely follows this intrinsic communication technique where the telephone has a hearing cup and microphone - the caller will tell an operator who he/she wants to talk to and the operator will establish a link between the two parties. This design is purely simple and intuitive, however, it is infeasible for a system with many users. Phone numbers are deployed for a larger system, with many users, to map each individual to a number. Humans use context to associate a person with an event and recognize relationships between subjects so they can quickly recall the reference. All of these contexts have become an abstract number - a quick fix introduced by engineers because of the incapability to decode human’s contexts. The users trade these contexts for a number to remember, a keypad to dial, and a contact list to keep.

In modern smartphones, the personal contact list is stored in the phone and can be easily retrieved. Most smartphones now have the voice recognition engine that allow the user to give vocal command such as “call my wife” and the phone will search the personal contact list and make a call accordingly. Thus, the most advanced solution resembles the first mechanical solution which closely follows the human intrinsic communication model. Figure 1 shows a representation of these phones.

The main pattern of voice communication is: vocally initialize the conversation, vocally communicate, and vocally terminate the conversation.

3.2 Typing Keyboards

Long before the invention of keyboards, humans have been scripting onto cave walls to describe events. And in the modern time, we are doing the same thing with slightly different styles and materials. The first typing device was designed and patented in the 1700s, and the first manufactured typing devices came around 1870s.

Later on, the invention of the keyboard allows the users to mass manufacture their messages easily. In the early days, typesetting, scripting, and typing were done through an operator, where the user/author provided the operator a script to make imprints. Eventually, typewriters and computers become popular and accessible for personal and individual use.

Currently, the modern digital computers are dominating most of the printing revenue; the keyboards look very much the same whether it is a physical keyboard or a virtual keyboard displaying on a device’s screen.

While keyboards are different both in physical presentation and mechanism to make imprints, their functionality is identical – allowing the user to script consistently. The current mobile technology and touchscreen has a new realm of

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**Figure 1.** A wooden wall telephone with hand-crank [left], an Internet Protocol (IP) phone [center], and a smart phone (iPhone)[right]
keyboards. Figures 3 shows different types of modern keyboards.

![Image](image-url)

**Figure 3.** One-handed keyboard [left], computer [center left], Virtual keyboard on a smartphone [center right] and hologram projected keyboard [right]

Nowadays, users can dictate their messages on mobile devices that are equipped with virtual keyboards and integrated voice commands. As it has been shown, the fundamental operation need for the keyboard is for humans to encode their message either through dictation or by directly choosing the symbols.

*The main pattern of keyboarding is: persistent transcription by selecting familiar characters/words/sentences/paragraphs, preferably in bulk or premade template.*

### 3.3 Thermostats

The thermostat is another popular and interesting interface. The main functionality of the thermostat is to trigger a signal when the temperature is reaching a preset point. The main use of the thermostat is to activate the air-conditioner or the heater to keep the temperature in a preferred range. The traditional mechanism to control temperature, especially in a closed building, is to open the place and let the air get through when the place gets hot or close the space and provide more heat by burning some wood/fuel when the place gets cold. Humans in the modern day are doing the same thing.

The first invention of the thermostat is credited to Cornelis Drebbel who designed a regulator, a column of mercury and a system of floats and levers to keep the temperature of a portable oven steady. The first patented thermostat was designed by Albert Butz in 1885, patterned in 1886 as a thermo-electric regulator. Thermostats come in many shapes, sizes and functionalities. The newer thermostats are built on digital circuits, which are capable of accommodating different users’ settings for preferred temperatures at different times as seen in Figure 4. While the addition of digital computer processing power into the thermostat is a great idea, it did not work out very well due to the cumbersome programming task. And the programmable thermostats do not save energy [9].

![Image](image-url)

**Figure 4.** Thermo-electric regulator[left], 1968 model w884 with dials to control both temperature and humidity [center left], and 1986 - chronopher III - programmable thermostat [center right], NEST- an intelligent thermostat [right]

Lately, the introduction of NEST, as seen in Figure 4 (right most), an intelligent thermostat that allows the users to set the temperature exactly the same way as they would do on the 1968 thermostat model w884. The difference is the NEST uses its computing capability to record the user’s preference and auto program itself [NEST has many other advanced features that we are not addressing in this study]. This feature certainly could have been implemented over half a century ago on the first model of the programmable thermostat, however, the simple concept was overlooked leading to hundreds of unwanted complicated interfaces.

*The main pattern of operating the thermostat is: simple adjustments of temperatures as needed. Precision is not important, but similar setup is expected daily or weekly.*

### 3.4 Credit Card Payment Methods
Since the very early days, humans have two systems of trading - direct trade and credit trade. In direct trading, an item is traded for a service or another item with equivalent value. In credit trading, one party may not have a physical item or money for trading but he/she has reputation or proven that he/she has the capability and willingness to repay with similar value of the item that he/she wants to get. Credit trading is flexible and convenient; thus, a third party is often needed to help authenticate and manage transactions. Credit cards, represented as charge plates and credit coins, had been used since the 1800s until the plastic card was introduced in the 1960s [10].

Advancements in telecommunication technology have a great influence on how credit trading transaction is done, which leads to different development of interface for debit/credit card authorization. The plastic cards are now equipped with a magnetic strip containing the owner information that can be extracted easily by a magnetic card reader [as seen in Figure 5], and this information can be transmitted through the existing telecommunication system for processing. Modern card readers are usually integrated with the vendor’s point of sale computer system to communicate with the card issuer for authentication and approval of each transaction.

The interface for processing credit/debit cards usually involves the authorization step: The cardholders pay for their merchandise by presenting the card to the merchant for processing. The merchant then sends the credit card information along with the purchase details to the card issuer for verification and approval. Common information needed for a transaction authorization are: card number, expiration date, amount request, and possibly a pass-code on the card that is not stored in the magnetic strip (for added security protection).

The most popular interface for card processing is at the point of sale where the merchants obtain the card information for authorization and further processing. Traditionally, the merchant authenticates a card by calling the card issuer with the card information and have the cardholder verbally confirm their identity and the transaction with the card issuer. This technique is the best method against theft, and it is the method of choice for large transactions today.

Recently, card readers can utilize the Internet and the cellular telephone network for transmitting their data. Thus, leading to development of card readers that can be attached to a mobile device. Card issuers also equip the new cards with a micro-chip to prevent vendors from storing the card owner information electronically. Ironically, the user information is still imprinted on the card.

The Internet also leads to the development of online stores that prompt the card holders to enter the card information. Despite the differences in the platforms used, all the information needed for a card authentication is very much the same.

The most notorious development of the mobile system would be ApplePay and AndroidPay, which allow the users to enter their credit card and banking information into a capable phone prior to the first purchase. The user makes a payment by bringing his/her mobile device next to the reader and hitting a button. The token is transmitted wirelessly to the reader, which in turn sends the token along with the transaction details to the server for authentication. Neither the user’s personal information nor the funding information is stored on the mobile device or transmitted to the reader, thus securing the transaction even if the token is intercepted by...
an unwanted party. ApplePay uses a sensor to check owner’s fingerprint when he/she hits the button to make a payment, while AndroidPay currently uses a password for older devices and fingerprint sensors on new devices.

Since most people tend to use their mobile phones several times daily, their phones are more readily accessible and get more attention than a credit card in a wallet. In addition, ApplePay and AndroidPay will give an immediate notification of any transaction to the phones alerting the users of a new transaction and making AppplePay and AndroidPay more secure.

![Figure 6. ApplePay [left] and Androidpay [right]](image)

The main pattern of credit payment methods is: simple and secured mechanism for exchanging wealth. Validation of transaction authentication with actual authorized user of each transaction is expected.

3.5 CAPTCHA: Human-Recognition

The capability to distinguish human’s actions from others’ is instrumental in many situations. For example, to know if someone is at the other side of a closed door, one could ask “who is there?” And if there is a human voice answered, we are sure that there is someone at the door, and most of the time we would know who that is if we can recognize a familiar voice. In many situations, a person can recognize a loved one from reading a few lines of text on a piece a paper hidden in a bread roll smuggled into a highly secure prison or from a washed-ashore piece of paper in a bottle. Humans can do this, with little or no effort, because they can recognize the meaning of the action and the context in which the action occurs, either in the past or in the future. This capability, while intrinsic to humans, is a very difficult process to automate. And it is one of the critical tasks on many online systems to avoid systematically abuse by computer programs. For example, an email registration system would give each user a chance to input his/her data to obtain an email address. A computer program can easily submit a large amount of random data to the system in a short amount of time to register for many email addresses. It is an impossible task for humans to sort through, recognize, and eliminate the illegitimate submitted data. It is very difficult to implement a program to distinguish a human action from a computer generated action designed to simulate a human action.

One popular mechanism to detect human action from a computer’s is through a CAPTCHA, which is short for Completely Automated Public Turing Test to Tell Computers and Humans Apart and introduced by Luis Von Ahn et. Al. in 2000[11]. Through a CAPTCHA system, the user is presented with a task to resolve, and the result is evaluated for correctness. Some popular CAPTCHAs are: solving a simple math problem, script/type down a message from an audio/video segment, recognize some distorted text, arrange humorous cartoon pictures in the appropriate sequence, etc.[12] and [13]. These CAPTCHA systems are easily programed to generate CAPTCHA tests and evaluate the results of the tests.

There are two major problems of existing CAPTCHA: (1) it is difficult and time consuming for humans to do the task right and (2) the computer programs can solve most of these tasks effectively. Thus, the existing CAPTCHA becomes an extra burden for the human and an ineffective deterrent tool that may be able to discourage novices from abusing the system. Current advancement in artificial intelligence enable computer programs
to crack up to 90% of the CAPTCHAs used in Google, Yahoo, and PayPal websites [13].

The latest development of CAPTCHA is No CAPTCHA from Google, where it prompts the user to click on a checkbox confirming that they are not a bot - a computer program. Obviously, clicking on a checkbox is easy, which requires little effort both from the human and a computer program. Google tracks the movement of the mouse and compares that to human patterns of mouse movement to detect similarity and compare that to other knowledge about that particular user Google has collected. If Google does not obtain a high enough confident level that the action is being taken by a human, it will prompt the user to click on images with the same context with a given sample image, from a given set of images. For example, the user is asked to pick out turkey images from a set of Thanksgiving images including turkey, bread rolls, jam, etc. given in Figure 7. The pictures taken of different types of turkeys in different angles are intuitive for human to recognize with little effort but are time consuming for computer programs to detect. Google’s No CAPTCHA system, while still is very primitive comparing to humans, is the closest thing to how humans would recognize a human’s action - ask for a simple task and recognize the human action by the rich knowledge common and shared among humans.

Most of human operations are done with an intention to accomplish a task, such as press-down on the gas pedal to accelerate a moving vehicle, dropping a letter to the mailbox to mail a letter, shred a sheet of an important document to destroy it, or turn/off the TV, etc. Humans operate with the same intention when they are on computers. When a user selects a file, then presses the “Delete” key on the keyboard or right-clicks on the computer mouse and chooses “Delete”, his/her intention to remove that file is clear; thus, the computer should perform the requested action. Most Unix/Linux based systems operate this way. Unfortunately, the vast user-friendly computer systems and applications that rely on Graphical User Interface (GUI) such as Windows are generally not designed to work that way. This case study examines the alert and confirm sequence, however, we should be able to relate to all other computer systems in a similar way.

Working on a computer system sometimes is a cumbersome task when the user’s intention is clear, and the system keeps asking for confirmations. For example, on Windows system, when a user wants to organize and clean up his/her desktop space, she/he deletes some of the un-wanted files. The system will prompt every time a file is deleted as seen in the Figure 8 [left].

![Figure 7. Google’s no CAPTCHA reCAPTCHA](image)

The main pattern of CAPTCHA is: simple and reliable way to verify a human is actually initiating the request.

3.6 Alerts and Confirmation Sequences

![Figure 8. Alert and confirmation of deleting file in Windows](image)

When the user is removing a large file, another confirmation will popup alerting the user that the file is too large to fit in the Recycle Bin as in the Figure 8 [right]. Finally, when the user tries to empty the Recycle Bin, another alert
pops up, telling the user that the files will be deleted permanently.

While these alerts have a good intention to let the user know the consequence of his/her action; however, it is annoying and unproductive, when the user’s intention is clear and the computer stops the user from doing anything else unless he/she responds to the alert. The only usefulness of this alerting system is that when the user accidently performs an unintended operation such as when his/her palm touches the touchpad causing a file to be moved into a nearby directory – unfortunately, the current Windows system would not give any indication for this type of operation. Thus, the accidental operations are slipped through without notice and the intended operations are delayed at every step with these mindless alerts. This model of alert, confirm, and re-affirm operations exist in all computer systems, varying by some pre-determined perception of how important an operation is or how severe the consequence of the operation is. These alert and confirmation sequences are also popular in most web-based applications, in which the developers put them in as protection mechanisms regardless of whether it is actually needed or not.

A more accepted alert system is the one that is discrete and does not interfere with the user’s task. For example, Google’s applications show a small non-interfering alert message immediately after an action is performed allowing the user to revoke the operation if needed. The message will go away in a few seconds and does not interfere with user’s current task.

In this approach, the user’s action is always performed, and the user is given a notification of the action and given a chance to revoke the operation if the user action is done by mistake. The notification does not need any user’s interaction and does not hinder the use of the application. Thus, this alert system is more helpful and natural to the way humans operate.

The main pattern of alert and confirmation is: notifying the user immediately of critical situations without interfering with the user’s current interaction with the system. The user can take action or ignore the notification.

4 INTERFACE DESIGNS WITH NEW METHODOLOGY AND EVALUATION

To test our methodology, we have two independent groups, each with 15 members, evaluating Walmart.com (the world’s largest company by revenue according to the Fortune Global 500 list in 2016 [14]) retailer in online order interfaces, the NEST thermostat and the new chip-equipped credit cards in two rounds. The first round is a blind test for user experience. The second round is reevaluating their user experience infused with our design pattern discovery and then design the next generation interface. The first group consists of individuals who have some direct or indirect experience with the test subjects (shopping online, the NEST and the chip-equipped credit cards).

4.1 Designing an effective online order web-forms

Web-forms for online order checkout is fundamental to all online transactions. We have amateurs who only get a few minutes of training to improve Walmart’s checkout web-forms (Walmart.com). Walmart, Inc. is the largest retailer in the world which employs a very large software design and support groups.

Round 1: In this round, each member is asked to timely make an online purchase of an item showing on the front page of Walmart.com as a new patron. Each member records the number of steps he/she has to go through and the data must be provided at the level of mouse clicks and keyboard strokes, excluding any mistakes.
All members are able to proceed to the page where they can submit their order after going through the following interfaces: (1) provide their name, email and password (twice) to create a profile, (2) choosing a shipping option, (3) provide a complete name (again) and shipping address, (4) provide full detailed credit card information and billing address, (5) review the order and submit. A screen capture of one of these interfaces is shown in Figure 9.

Figure 9. A checkout web-form from Walmart.com taken on August 25, 2016

When asked about the purchase experience, all members express that their checkout experiences are fine besides some information are asked twice such as name and address. When they are asked to redesign the check-out web-form for Walmart.com, the new interface is similar to the existing one where the redundant fields asking for name and address are removed.

Round 2: All members are asked to describe a scenario where they make a quick purchase of an item (not online). Most members describe their experiences of a purchase at a gas station or a convenient store where they pick up an item, swipe the credit card, and then sign the pad; or pump some gas where they insert a credit card, put in a pin or their postal zip-code to complete the transaction. The members are asked again for their experience with the online purchase from Walmart.com, and they all express that it is not as good as they thought.

For this round, the members are asked to design a new online processing interface for Walmart.com to minimize the user’s interactions and still achieve two key-tasks: (a) complete a purchase and get a customer profile for the seller. Majority of the new interface is a single step simple web-form that prompts the users to provide (1) a credit card number and the corresponding postal zip-code. The postal zip-code is used to authenticate the card and obtain the customer residing city and state, (2) shipping street and the building number – the users can change this information if they want to send to a different address, and (3) an optional field for email or phone number if the user wishes to get a receipt copy forwarded to the given email or phone (as a text message). The new interface is shown in Figure 10.

Figure 10. One-step checkout web-form redesigned for Walmart.com. A change in the auto filled shipping zip code field indicates the billing address is different than the shipping address.

When the user submits an order, the transaction is completed. The user is presented with the complete order details where he/she can make changes if needed. At the server, the order will be delayed 30 minutes after the last change made to the order before sending to the processing center – which is also a common practice in the industry. With this simple interface, the members justify the users will have minimal interaction similar to their transaction at a gas station with the addition of providing a street address for shipping. And the
company still be able to create a profile for the customer by sending the customer a computer generated link/password to access their online orders on the electronic receipt to the email address or the phone number the user has provided. The user is not asked to enter his/her name, and the justification is that the name can be obtained by looking up the phone number, the cashier can obtain the name at the time of pick up in the store, or the system can prompt the user to update his/her profile the first time he/she signs in online. Thus, there is no need to offend the users by asking for their names if all they want is to purchase the items and move on without wishing to establish any relationship with the store (even in this case, the new interface is still able to get enough information for the user’s profile).

4.2 Designing Next Generation Thermostat Interface

The NEST thermostat is chosen for its modern and simplistic digital interface.

Round 1: In this round each member is asked to operate the NEST to control the room temperature with different preferred settings for common daily periods such as waking up, leaving for work, arrive after work, going to sleep for one-week time frame. Each member is then asked to evaluate their experiences with the NEST thermostat. All members in both groups express that they like NEST’s slick, modern looking digital interface design and its ability to learn user’s preference temperature patterns. There are 7 members who have no prior experience with the device interface that express that they need a little time to learn how to use NEST.

Round 2: All members are briefed on traditional and existing thermostats, including how to operate them. All members are asked to design the interface for the next generation of thermostat. It is surprising that the members have chosen the design of Honeywell 1968 model w884 with dials to control both temperature and humidity as seen in Figure 4 as their base design in which the users can turn the knob to the left to decrease and to the right to increase the setting. The displayed dials will be digital and a large number will be displayed for better readability as the user starts turning the knob. This design is truly simple and intuitive to use. This new design is very similar to the NEST, however, the users do not have to push the knob, which is not intuitive for users who are new to the technology. In addition, the dials give the users a reference so they can adjust their knob turning speed with minimal attention to details.

4.3 Designing the Next Generation of Secured Credit Cards

The chip-equipped credit card: credit cards are commonly used in industrialized countries. Secondly, the threat of credit card frauds makes users open to adapt to a new and safer technology.

Round 1: With similar setup to the previous case study, the members of the two groups are asked to use their chip-equipped credit cards to make their daily purchases for a week. The members are asked for their experience. All members acknowledge that the new card takes much longer time to process (~ 1 minute while non-chip card take less than 5 seconds) and they have to keep looking at the card reader digital display in order to know when the transaction is done. Despite these issues, all members express that they like the chip-equipped card because it makes them feel more secure when making transactions. This is an expected result because these credit card users are concerned about fraud and will sacrifice usability for extra security.

Round 2: All members are briefed on how the chip-equipped card handles its user transaction information. The members are asked to review the information on the chip-equipped card and a
non-chip card. The members are then asked to design the next generation of credit cards. The members come up with two designs: (1) modifying the card readers for user experience and (2) redesign the card for true security.

Design for better user experience: in this design, the members want the card reader to be redesigned to read both the magnetic stripe and the chip on the card in one swipe. This way, the users do not have to swipe again whenever the reader fails to read the chip. It is also cumbersome that the users must check the card reader capability and to remember which card to swipe and which card to insert for every transaction. Moreover, the card reader should give an easy recognizable signal such as light up green on “processing” and light off on “done”. These modifications help to improve user experience.

Design for true security: this design addresses the security of the transaction and the user’s experience. In this design, the card is similar to the non-chip card; however, there is no name, credit card numbers, nor signature. There is only an encrypted alpha-numeric sequence of characters that can be decrypted by the credit card processing center. When the user makes a transaction, the point of sale computer terminal will receive an image and the name of the actual owner of the card so the salesperson can verify the identity of the buyer. For each transaction, the user will be asked to provide the pre-registered information such as birthdate, pin, billing zip code, phone number, income range, driver license expiration date, etc., selected at random. This information is currently and normally available to the credit card issuers. Thus, with this design, the card can be used securely for both online and in store purchases because the user’s personal information is no longer on the card.

4.4 Evaluation of the Next Generation Interfaces

The members who participated in our study are college students that are interested in technology and computing, and majority of them have no prior experience on interface design. However, their designs are simple using existing technology, and resemble existing interfaces.

We evaluate the new interfaces with 10 new members who have not participated in any previous activities. We use the following evaluation criteria: functionality, user’s perception, learnability, interface complexity, and task completion time.

The functionality is simple to evaluate because the new interface must carry the same functionality as the existing ones; The task completion time is simply the time the users take to complete an assigned task. Learnability is reflected by the number of mistakes and the amount of time the users take to complete the task. User’s perception is user’s preference on which interface they would rather use after trying them both.

For interface complexity, we use Tullis’ simplified screen complexity method [15], to evaluate the new interfaces against the corresponding existing interfaces. In this method, the components on each interface is organized into rows and columns by their alignments; the sum of all rows, columns, and the components in each row and column are the complexity score.

With these setups, the result on the new interfaces are all better than the existing ones. Especially, the check-out web-form redesigned for Walmart.com reduces almost 80 percent of required information and total work the users have to perform and still manage to have the same functionality.

In term of handling fundamental functionality and operations of the thermostat, the new design is more user friendly. All other criteria
are mostly comparable with the existing NEST thermostat.

The credit card designs are also better than the one that have been designed by large credit card issuers. The credit card first design improves the user experience by cutting down on different tasks the user may have to do. And the second design is truly exceptional. It provides the best security and flexibility for credit card users by modifying the existing interface of the existing software that is currently used for non-chip cards. The new design is more secure and simpler than the existing chip-equipped cards.

5 CONCLUSION

Designers should study the evolution of interfaces designed for similar tasks to find the pattern of a good interface design. A new user interface design should maximize the capability of the technology to provide the users with greater functionality and minimal impact on how the problem is being solved. Through our case studies, we have shown that there is a pattern of successful interface design across the evolution of many different problem domains; and that a successful design pattern often exists in the primitive classical interface designed for the problem.

REFERENCES


