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# Using Mnemonic Techniques As Part Of Pictorial Interface For Self-identification Of Illiterate Villagers

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## **ABSTRACT**

Various government departments in India are thinking of offering personalized services through touch screen kiosks to the illiterate villagers. Establishing the identity of a person and its verification becomes very critical while offering such services. This paper proposes use of mnemonic techniques as part of a pictorial interface for self-identification of illiterate villagers. It banks upon the existing visual literacy of villagers. The experiments documented in this paper help in identifying the effectiveness of a visual imagery mnemonics and other complementing mnemonic techniques for recalling the sequence of pictures by the villagers. Terms like *pictorial identity* for login name and *pictorial signature* for password are coined for the proposed self-identification process. The metaphorical aspects of using a series of pictures as one's identity and signature are also explained. The paper also compares the proposed ideas with Passfaces.

## **KEYWORDS**

Illiteracy, Visual Literacy, *Pictorial Identity*, *Pictorial Signature*, Touch Screen Kiosk, Interface Metaphor, Recall, Visual Imagery Mnemonic, Mnemonic Techniques, Mental Model, Self-identification, Passfaces

## **INTRODUCTION**

Several government departments in India are considering the possibility of offering variety of services to the villagers in rural parts of India through touch screen kiosks. These services include information and guidance pertaining to health, agriculture, market rates for agricultural products, opportunities for artisans, education, voice messaging, finance and governance. Major impediment in the effectiveness of these initiatives is the illiteracy of people. Secured and personal space for every villager becomes important if the services are to be personalized.

Indian government planned to issue three million Kisan Credit Cards for loan disbursement to the farmers in rural parts of India in 1998. But finally, the scheme has been absolutely ineffective [Business Line, 2003], [The Tribune, 2000]. Articles published in news papers ironically mention about a bare-chested man dressed merely in *Dhoti* using a debit card. One of the reasons behind the ineffectiveness of Kisan Credit Card scheme was ensuring the identity of credit card holder.

The question arises that how will they establish their identity if they were to seek any services from the kiosk?

### **Lack of Process Orientation**

Taking care of a delicate smart card does not match their hectic and rough lifestyle. Also the chances of illiterate villagers misplacing the smart cards are very high. It should be noted that most villagers are not used to managing documents. They are not so much process oriented.

### **Lack of Fine Motor Skills**

Another alternative for establishing the identity is to type the login name and password. But the touch screen kiosks usually do not provide a keyboard. Even if we assume that the keyboard is made available, still the typing by illiterates is a problem.

In our experiments at Darevaadi (a village in Ahmednagar District, Maharashtra State) we observed that the villagers are unable to use the computer keyboard. We had asked them to use only forward, backward, left and right keys for navigating through a terrain walkthrough. Their fine motor skills are very poor. In many cases, we saw that while pressing a key, they ended up pressing two/three more keys around it. Their hands shiver while pointing a finger at the key as they usually perform extremely laborious tasks.

This shows that a secured system for offering services to illiterate villagers through touch screen kiosks is a paramount need of the country.

### **Illiteracy, Diversity and Large Population**

Another idea is to provide assistance in the beginning while creating the user account. This sounds all right. But how will they recall the keys for typing their name and password the next time. And how will they decide the password and then type it? If they take assistance from someone then the security of password is questionable. This is a huge problem if considered the approx. 400 million illiterate population of India [Statistics by Education Department, Government of India, 2001]. On top of it, India speaks over 300 different languages and dialects (officially recognized). Some of them do not have scripts at all. Not all are supported on computer from among those that have scripts.

Therefore a simpler mechanism needs to be devised so that an illiterate villager is able to establish his/her identity and log into the system. Of course, verification of identity could be performed using the latest fingerprint recognition systems, if they are affordable enough. They are prohibitively expensive for a developing country like India. This technology is still to be introduced in revenue generating organizations like banks and airports of India. Proposing it for offering services to illiterate villagers is quite unrealistic [PWW, 2004].

Therefore it is proposed to design a pictorial interface, which will enable the illiterate villagers in defining their *pictorial identity* (login name) and *pictorial signature* (password). The *pictorial signature* is a metaphoric concept. The idea is to avoid usage of text and rely on the visual literacy of villagers. Such interface is proposed as one of the many alternatives for establishing the identity of a person.

The discussion so far can be summarized as under-

### **Constraints**

Illiteracy, Very large population

### **Strengths**

Using the visual literacy of people to counter the impediment of script illiteracy in the given scope of problem.

## **OUTLINE OF PROPOSED SOLUTION**

1. Our idea is to use a collection of pictures that will be selectable from a touch screen kiosk. The pictures should be familiar to the villagers.
2. A villager should be able to select a series of pictures (around 4 to 8 of them) of his/her choice to serve as a login name.
3. (S)he should be able to select another series of pictures (around 4 to 8 of them) of his/her choice to serve as a password.
4. (S)he should be able to easily recall the *pictorial identity* (login name) and *pictorial signature* (password) for inputting it in the system through touch screen kiosk for availing the services.

## **THE ISSUES TO BE ADDRESSED**

At the outset of this experimentation some issues were already identified to be addressed. These are enlisted in the form of questions.

- Which type of pictures will be easily recognizable to villagers?
- How many (minimum and maximum limit) number of pictures are required for defining the login name and password?
- Will the villagers be able to recall the sequence of pictures?
- What is the solution if they are unable to recall the sequence of pictures?
- How large the collection of pictures should be?
- How will one browse through a large collection of pictures?
- How many unique login names and passwords can be generated with such pictorial interface?
- It should be possible to create minimum 2000 unique login names and passwords. As the average population of an Indian village is approx. 2000 people [e-Census India, 2003].

In order to find answers to these questions, a couple of user interface prototypes are designed. They have been tested over several subjects. Based on the results of testing the guidelines for such pictorial interface are evolved.

## **APPLICATION OF INTERFACE METAPHOR**

Representing 'login name' and 'password' as a series of pictures is a metaphorical idea. As majority of subjects select only those pictures, that are meaningful to them, that are associated with their activities and that reflect their aspirations. Basically they choose the pictures with which they can relate themselves. The series of pictures in the form of *pictorial identity* and *pictorial signature* is indeed a metaphorical representation of the person. It reflects his/her mental model. Using pictorial interface for self-

identification is quite an unconventional [Katre, 2002] application of interface metaphor.

Such pictorial interface can prove most suitable in India, as most oral cultures tend to use visual metaphors unlike the Modern Western European ways of thinking influenced by print culture that tends to use verbal metaphors [Clair, 2000].

Hereafter, 'login name' and 'password' will be referred as *pictorial identity* and *pictorial signature* respectively.

It was evident that we needed to take help of existing 'visual imagery mnemonic techniques' [Baddeley, 2000] or devise new mnemonic techniques.

## EXPLORING WITH MNEMONIC TECHNIQUES

### Mnemonic Experiment 1.

**Task:** Select two series of seven pictures each from a set of 50 pictures and recall them in same sequence as they were selected after a gap of 15 minutes. Subjects were expected to remember both series of pictures.

We showed around 50 pictures in one screen to both illiterate (from a village) and literate (from a metro city) subjects. They were asked to select two series of seven pictures each (totally 14 pictures) out of 50 pictures as seen in Figure 1. Let us say the first series of pictures represented the *pictorial identity* and the second series of pictures is the *pictorial signature* of the subject. We chose both illiterate and literate subjects in the initial test to find the difference in mnemonic techniques used by them. The observations of the test are categorized below.

### Preference

- Both type of subjects preferred the pictures that represented their worlds.
- A very prominent number of literate subjects selected pictures of washing machine, television, car, aircraft, space ship, mango juice, bike, etc.
- Whereas the illiterate subjects showed distinct inclination for pictures of cattle, bullock cart, tractor, well, gods, etc. Several of them also chose the picture of television.

### Recall of pictures

- In this experiment, many illiterate and literate subjects did recall all the first series of 5/6 pictures selected by them after a gap of 15 minutes.
- Those who chose pictures that lacked concrete theme or the theme was not evident enough or the picture was ambiguous to them got confused e.g. herd of buffalos, barren land, etc.

- All pictures with concrete themes were recalled perfectly e.g. television, bike, bullock cart, well, hut, gods, cow, etc.
- Many subjects recalled the pictures based on their size, shape and location.

More precisely, the pictures they could identify and verbalize were recalled better. Therefore, the spoken language did come into play even though we wanted to avoid it. The pictures that mapped with their existing vocabulary of words were easy to recall. Illiterate subjects did not choose pictures like spaceship and Einstein's portrait, as these are unfamiliar to them.



Figure 1. All pictures exposed in one screen

### Recall of sequence

- Many of them recalled the sequence of first series of seven pictures to a certain extent. But majority of them jumbled up the sequence of second series of pictures.
- This resulted as most of them started the selection of pictures from top row and then after initial 5/6 steps they chose the remaining pictures quite randomly.
- The percentage of illiterate subjects failing to recall the sequence was much higher.

- Literate subjects could recall the sequence to a certain extent as they are trained to remember and write the spellings of words from left to right. Furthermore, they are also used to pronouncing the password after coining it. Illiterate subjects have no clue of it.
- Average human limit to recall +-7 items [Miller, 1956] also seemed to be a reason for failing to recall.

### Visual Quality

- Exposing all 50 pictures in one screen made the task tougher due to visual chaos.
- The pictures appeared too noisy in terms of color and cognitive load on the subjects.
- Pictures with flat backgrounds received greater preference from all subjects.

### Challenges

- What we had to achieve now is to modify the picture selection process in such a way that the sequence of selection gets registered in the minds of illiterate subjects. Or the system itself takes care of the sequential selection.
- We also needed to articulate the complementing mnemonic techniques used by the subjects.

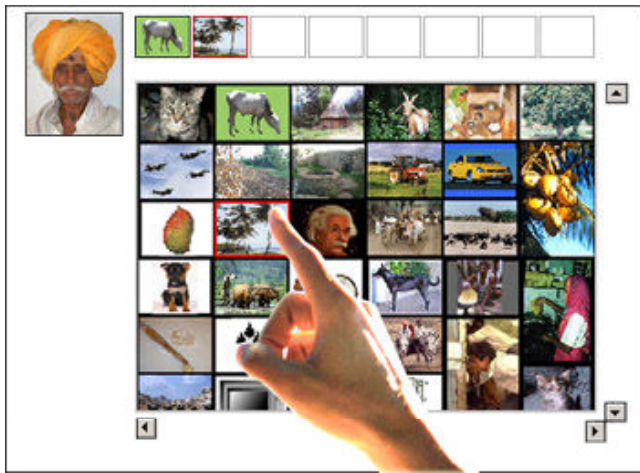


Figure 2. Pictorial identity as my own photograph

### Mnemonic Experiment 2.

As subjects could not remember 14 pictures at a time, we decided to consider other alternatives. We thought that a person's photograph itself could be used as his/her *pictorial identity*. In this option, only the signature will be represented in the form of pictures. The visualization of interface can be seen in Figure 2. But in this case we realized that a villager would find it extremely difficult to identify his/her photograph from hundreds of other villagers' photographs. It would be almost impossible to

search it without use of text input, which is ruled out in case of illiterate villagers.

As a result of this realization we decided to represent the identity of a person also as a series of pictures.

### Mnemonic Experiment 3.

#### Sequential Peg Screens

In this experiment, we distributed the images over 4 screens. Each screen included approx. 3x3 grid of pictures. The fourth screen included a 3x3 grid of 9 distinct colors. The subjects were expected to select any one picture from each screen. After selecting a picture, the application automatically switched to the next screen. We also ensured that the selected image appeared in the vacant slots at the top portion of the screen. Figure 3. shows the arrangement of peg-screens.

#### Length of Pictorial Identity

This time the length of every visual identity is only 3 pictures long.

#### Length of Pictorial Signature

The length of visual signature is 4 pictures long. The 4<sup>th</sup> frame was to be filled by selecting a distinct color.

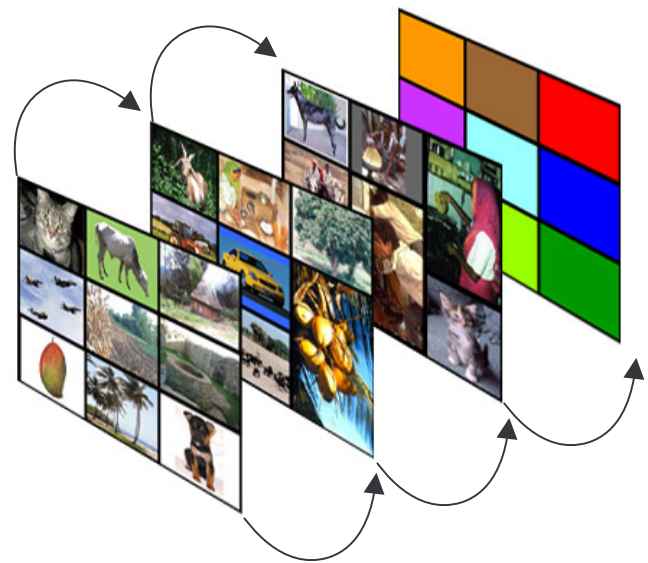
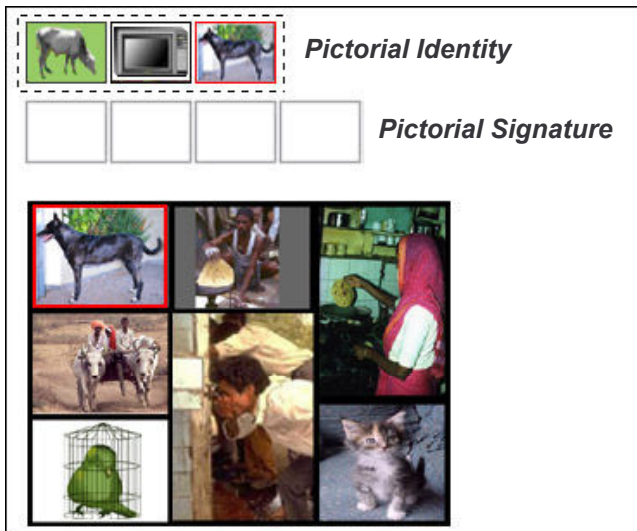


Figure 3. Screens as visual pegging device

Both *pictorial identity* and *pictorial signature* put together it becomes totally 7 pictures. This reduced the memory load to remembering of only 6 pictures and 1 distinct color. The color is automatically applied to both series of pictures. As per Miller's human memory limit, we fitted everything within the limit of 7 items. Figure 4. shows the arrangement of slots created for inputting the *pictorial identity* and signature.



**Figure 4. Picture Selection Mechanism**

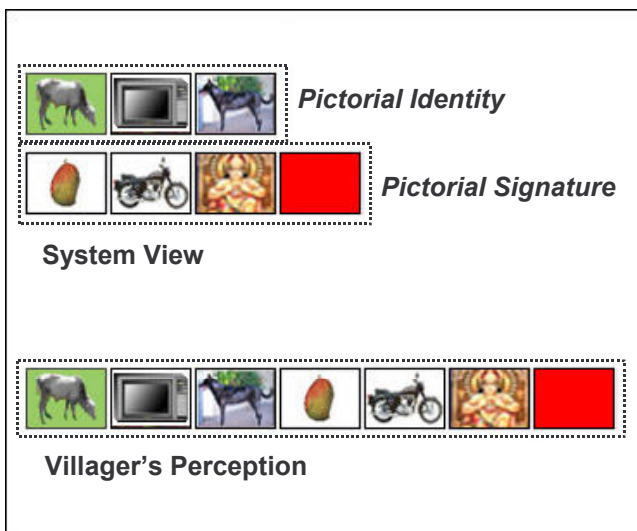
But in this case the question arises how many unique login names and passwords can we generate using 4 screens of 9 pictures each? The answer is simple.

$9 \times 9 \times 9 \times 9 = 6561$  unique combinations of 4 pictures each.

We have not considered the repeated use of pictures as villagers may or may not be able to count.

As mentioned in the introduction of this paper, the average population of an Indian village is approx. 2000 people. The proposed system can define 3 times greater number of unique *pictorial identities* and *signatures*.

This experiment was conducted with illiterate subjects only. The sequential presentation of peg screens forced a sequence while selecting the pictures. Most subjects did very well. Most of them recalled the entire sequence of pictures properly. This finalized the framework for picture selection. The visual peg screens really worked very well.



**Figure 5. System View and Villager's Perception**

However, we observed another peculiar aspect of villagers as shown in Figure 5. They did not perceive the duality of the series of pictures they were selecting. From their perspective, they were selecting only one sequence of 6 pictures and 1 color as their identity. It is only in system's view the series 7 pictures is divided in terms of *pictorial identity* and *signature*.

### PROVISION OF MULTIPLE MNEMONIC TECHNIQUES

We have witnessed that the subjects chose variety of mnemonic techniques in combination. Therefore the pictures should also fulfill requirements of following commonly used mnemonic techniques.

#### Location Mnemonic

The villagers should be able to recall the position of a selected picture (both in space and time).

#### Shape, Size and Color Mnemonics

All pictures need not be of same size and shape. The villagers should be able to recall the picture by its uniqueness of size, shape and color.

#### Classification Mnemonic

The villagers should be able to recall the pictures belonging to a family e.g. pet animals, flowers, fruits, etc.

#### Personification Mnemonic

The villagers should be able to select pictures that can represent their belongings, lifestyle, likes and dislikes.

#### Succession Mnemonic

The villagers should be able to select pictures that indicate the logical progression of stages of an activity or a scenario.

### COMPARISON WITH PASSFACES

The idea of Passfaces [Brostoff, 2000] does rely on recall of human faces as shown in Figure 6. But restricting the choice of pictorial identity and signature to a series of human faces has many weaknesses. Not many mnemonic techniques as mentioned in the earlier discussion can be applied with Passfaces. Our recall of images is anchored to various visual and conceptual aspects like shape, size, color, location, content, classification, associated meanings, personal choice, etc.

Also, the human faces tend to have racial characteristics. For example, one might find the faces of all Chinese, Japanese, Mongolian, Indian people very alike respectively. You start noticing the minute differences between the

Chinese or Japanese faces only after becoming familiar with the individuals.

Another weakness of Passfaces is that our recall of human faces is good only if we personally know the individuals whose faces are selected as part of a pictorial password. We do not like to remember the anonymous faces of people that we come across in public places.



**Figure 6. Passfaces Grid of Brostoff**

Therefore as proposed in this paper, the pictures that reflect entire cultural context of the targeted users and support various mnemonic techniques are most usable for pictorial authentication interface.

#### **PROVISION OF LOCALIZED VISUAL THEMES**

It is possible to distribute the pictures theme wise e.g. we could have agriculture, pet animals, daily activities, local festivals, gods and goddesses, and even the regional and national film stars. The present set of pictures does not cater to the choice of both male and female subjects. But this should be addressed.

The pictures should reflect the mental model of villagers. The pictures should be localized, as the geographical conditions and lifestyles are different in many states of India.

After a villager has selected his /her *pictorial identity* and *pictorial signature*, a printout of the same could be given to them. They may prefer to use it initially.

#### **CONCLUSIONS**

- It is possible to counter the illiteracy barrier by taking help of existing visual literacy of villagers.

- Sequential peg-screens are helpful in registering the sequence of pictures in the minds of villagers.
- Combinations of variety of mnemonic techniques enlisted in this paper can help in recalling the sequence of pictures.
- *Pictorial identity* and *pictorial signature* can be truly helpful in establishing the identity of an illiterate person.
- Proposed pictorial interface for self-identification can be a very cost effective solution for providing personalized and secured services through touch screen kiosks to illiterate villagers.

#### **FUTURE WORK**

We propose to enhance and expand the applications of this interface in near future. The tasks include-

Applications for children (who are just beginning to learn the scripts) can be explored. Various themes of pictures need to be tested on villagers. The gender based choice of pictures need to be addressed.

#### **ACKNOWLEDGMENTS**

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