Human and Computer

__One__, a robot may not injure a human being,
or through inaction, allow a human being to come to harm;
__Two__, a robot must obey the orders given it by human beings
except where such orders would conflict with the First Law;
__Three__, a robot must protect its own existence
as long as such protection does not conflict with the First or Second Laws.
— **Isaac Asimov in 'I. Robot'**

In this Appendix chapter, we discuss HCI, the interaction between Man and Machine which has been a quite successful approach.

The main thesis argued in this work is the INTEGRATED WHITE+BLACK BOX APPROACH, where we combine both white-box approach (which strongly utilizes human visual perception and intelligence) with black-box approach (which strongly utilizes computer strength in processing computations). Here, we elaborate various aspects from the two players involved: the human and the computer, to further support our arguments.

The Strengths of Human

Despite the ever increasing popularity of transferring our (human) works to computers for simplification of our life, there are still a lot of human tasks that cannot be done (or still poorly done) by *current*[1] computer, such as in areas of visual perception and intelligence.

To illustrate the strength of human over computer, we highlight the recent research in CAPTCHA [1] (Completely Automated Public Turing Test to Tell Computers and Humans Apart)[2]. Currently, CAPTCHA uses the following simple idea that: "It is generally easier for computer to generate visualization than to derive information from the generated images".

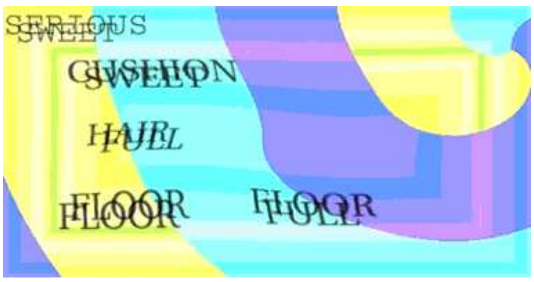

Figure 1: Gimpy [1]: What are the words written here?

While it is considered easy for human to read the extremely distorted and corrupted words in Figure 1. (There are six of them: Cushion, Floor, Full, Hair, Serious, Sweet), it is difficult (but

[1]Nobody knows whether future technologies will be able to take over the one or more areas where human is currently better. When that really happens, the works related with Human Computer Interaction around that areas must be revised.

[2]Nowadays, many web services use CAPTCHA to verify that the user is really human instead of a malicious computer program. For example, when a user sign up for a free e-mail account, he will be asked to do what human is known to be good at but difficult for machine. This is to prevent the free e-mail account to be auto registered by malicious web-bots spammers.

not impossible — as of mid 2007)) for the current state-of-the-art Optical Character Recognition (OCR) algorithms to correctly decipher the words. This CAPTCHA is called 'gimpy'. Gimpy works by randomly grabs few letters or numbers and then distorts them using different colors, stretching the letters, adding extra noises such as dots and lines, etc. Despite such nasty alterations, most human pass this test quite easily[3].

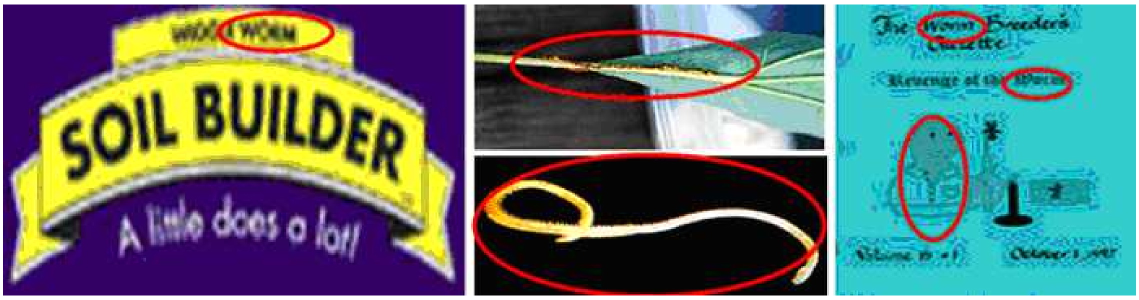

Figure 2: Pix [1]: What is the common object in these 4 sub-figures?

Another case of superiority of human visual perception and intelligence in deriving information is shown in another CAPTCHA called 'pix' (See Figure 2). Pix grabs four pictures with the same label (the pictures are already labeled by another human beforehand) and ask the user to find a single word that best describes the main object of the four pictures. Human can easily answer: 'worm' (circled), but at this moment, to the best of the author's knowledge, there is yet a computer algorithm that can connect the correlation between those distinct pictures.

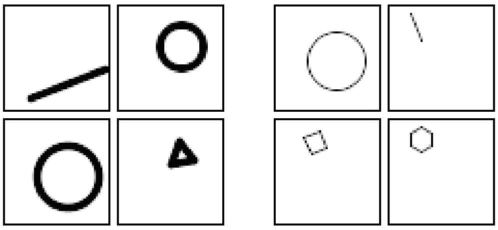

Figure 3: Bongo [1]: What is the major difference between the left and right figure?

In Figure 3, another CAPTCHA called 'Bongo' is shown. In this 'IQ test', the users are asked to tell the major difference of the 4 pictures on the left side versus 4 pictures on the right. The answer is easy for human: Pictures on the left are drawn with thick lines whereas the pictures on the right are drawn with thin lines. It seems hard to create a dedicated algorithm to accomplish the same thing.

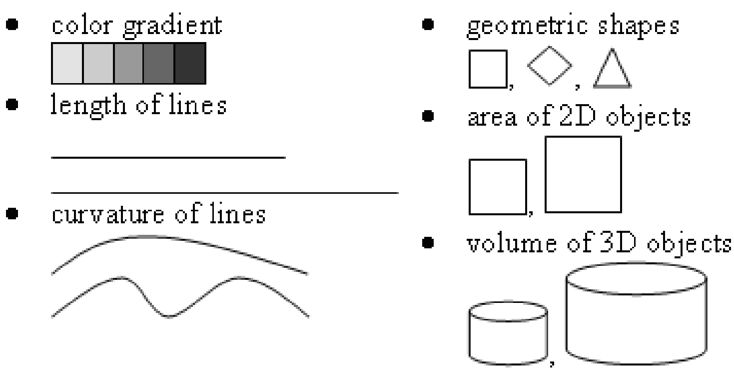

Figure 4: Examples of visual features that are easily identified by human.

[3]Sometimes, some GIMPY is set to be quite hard that even normal human has difficulties. The research between creating good CAPTCHA is still ongoing.

Yet another case is shown in Figure 4. Human can easily distinguish several visual features of whether a specific object in the given picture has an oval shape or triangle shape, curvy or straight, big or small, and so on. Computer needs a sophisticated algorithm to achieve the same feat and currently still not perfect.

So, although computers are much faster than human in numerical computation, human are still far better at carrying out low-level tasks such as speech and image recognition (shown above). This is due in part to the massive parallelism employed by human brain, which makes it easier to solve such problems.

Comparison of Human versus Computer

In Table 1, we try to elaborate the differences between human and computer.

	Human	Computer
Strengths	• Have common sense and bigger knowledge base, thus can percept his environment better than computer given appropriate means (especially in visual form). • Can think (synthesize) new rules 'out of the box'. • Psychologically, human decision is more trusted than computer expert system decision. • Can detect trends, patterns, or anomalies, in visualization data. • Good in learning.	• Speed: Fast. • Reliable. • Endurance: Not tired. • Unbiased. • Consistent. • Can try much more combinations than what human is capable of.
Weaknesses	• Easily tired and bored, thus can only be utilized for a short period of time, perhaps as 'oracle' only. • Cannot do micro manage. • Biased and inconsistent. • Can make error. • Not a perfect decision maker. • Actually cannot see anything if the data is presented in awkward manner.	• Difficult to synthesize new rules (cannot think 'out of the box'). • Limited knowledge base. • No common sense.

Table 1: The Comparison of Human versus Computer

From Table 1 above, we see that collaboration is possible. To maximize the benefit, each player should utilize his/its strengths to the fullest: Human should focus himself in doing what human are good and computer are not, and vice versa. Information visualization can be used to bridge the information flow between computer to human. In the context of addressing SLS Design and Tuning Problem like what we have seen in Chapter ?? and Chapter ??, we merge the individual strengths to form a better functionality as illustrated in Figure 5 and elaborated in Table 2.

Human	Computer
Understand 'the box': the COP fitness landscape and SLS Trajectory behavior.	**Process 'the box':** Run the SLS.
Think outside 'the box': Find insights of what is happening within the SLS	**Visualize information:** Compute FLST visualization, compute some statistics.
Improve the SLS Design: Add good search strategies.	**Fine Tune:** Use computer speed to fine tune the focused configuration space.

Table 2: Human+Computer Tasks in Integrated White+Black Box Approach

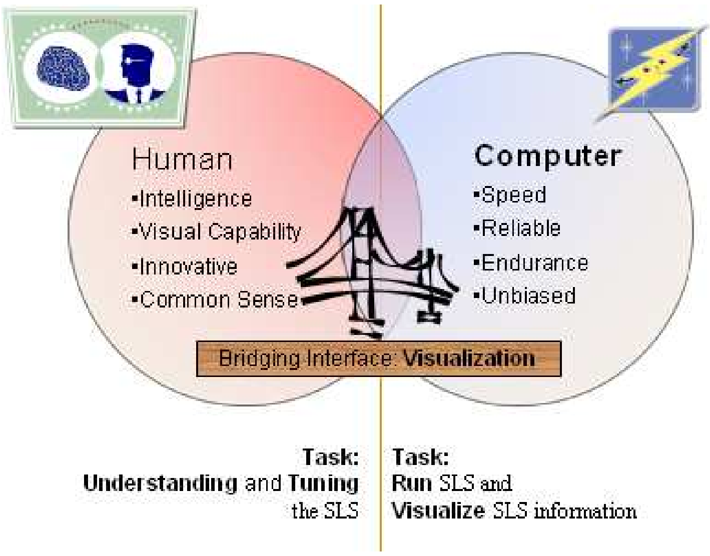

Figure 5: Summary of the Collaboration

Summary

1. The collaboration of two things is useful if and only if:
   (a) Both participants have some advantages that the other has not.
   (b) It can be proven that the advantages of each participant are complimentary for achieving the goals.
   (c) Appropriate interfaces are used.
2. We have shown that in the context of addressing SLS Design and Tuning Problem, human and computer in form of Integrated White+Black Box Approach are complementary and that information visualization can be used as a good interface to connect them.

Bibliography

[1] Luis von Ahn, Manuel Blum, Nick J. Hopper, and John Langford. CAPTCHA: Telling humans and computers apart. In *Lecture Notes in Computer Science*, pages 294–311. Springer.

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