The Simputer: access device for the masses[1]

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(based on discussions with the Simputer group)

1 Introduction

There is growing conviction at all levels that mass computerisation and access to IT is critical for India. It is conceivable that within the next three to five years the length and breadth of the country will be wired and connected to the Internet. Several traditional and innovative initiatives are already underway: expanding reach of the basic telephone service, use of wireless and satellite links, use of cable-TV network for Internet access, conversion of STD booths to info-kiosks etc. However, affordable access points– low cost computers with which the masses can connect to the emerging information highway are nonexistant. Even a cursory evaluation demonstrates the infeasibility of using the dominant Wintel platform as the vehicle for mass computerisation:

- The high cost of initial acquisition. The lowest cost machines in the market are in the price range of US$ 500 to US$800. At Rs 20,000 to Rs 30,000, such machines are far beyond the reach of even the lower-middle class.
- The equally high cost of maintenance and upgrade.
- The complete lack of user-friendly interface
- English being foreign to 90

Hence it is essential to develop a machine that is low-cost, usable and *useful* to the common man. In this concept paper we explore various aspects of such a machine. For the sake of brevity, in the rest of this paper we refer to such a device as the simputer (simple computer or, if you like acronyms, Simple, Inexpensive, Multi-lingual comPUTER, or, if you prefer ridiculously complex recursive acronyms, then; simputer- simple computer and the simple stands for Simple, In-expensive Multi-lingual PeopLE's :-). We also assume that the network infrastructure is in place and that it is easy and inexpensive for the user to connect the simputer to the network.

[1]The paper was written September 1998 and hence quite dated and incomplete. Its use is primarily historic.

2 Cost of the Simputer

Given the current buying power as well as the per capita income, a simputer at a price of about Rs 5,000 may be attractive to a large segment of the population. This price is still too high for individuals to own, but low enough that a large percentage of households can afford it. Clearly, the population below the poverty line has other priorities. If there is no sales tax, or customs or exercise duty, then the production cost of the simputer will be about US \$100. Hence in what follows the major constraint is this bottom line.

3 Uses of the simputer

There must be compelling reasons for the common man to posses and use a simputer. Whether Rs 5,000 is affordable or not depends obviously on the utility of the simputer. We list some of the potential application areas.

- Transactions: the simputer must facilitate ready and easy money transactions at all levels of granularity. Individual to individual transactions must be as easy as cash, but provide added advantages so that simputer transactions will be preferred to cash transactions. Access to and transactions with commercial and financial establishments (like banks, hotels, shops, train stations) must be simple.

- Communication: Beyond everyday monetary transactions, the other essential aspect of everyday life is that of communication. As has been widely observed, human beings are social animals. The simputer must enable communications at all levels at negligible incremental cost. Witness the droves of people all over the world that were lured to the internet by the prospect of cheap inter-personal communication in the form of email.

- Information: The third need that a simputer must fulfill is that of information. Access to the right information at the right time can dramatically improve the quality of life at all levels. For instance, the knowledge that the panchayat official is not available will save a tedious journey for a harried farmer. More valuable is the information that there is really no need to meet the panchayat official in the first place! the simputer must be the gateway to sources of such information that has significant local relevance.

- Other:

4 User-interface of the simputer

The user-interface will make or break the simputer. More dramatically stated, the simputer IS the user-interface. We want the simputer to be used by people who may be illiterate, or semi-literate in any of the numerous Indian languages.

For most applications, voice-input and speech output in the local language augmented by a minimal single-line display may be the best choice. This will dispense with the need to type in arcane commands or key sequences. However, this has two major drawbacks: the lack of robustness of voice-recognition in diverse operating conditions, and the awkwardness of having to verbalise every intent. The fact that the telephone keypad has found universal acceptance in the mushrooming STD booths all around the country, favors the addition of such a keypad to the simputer. The telephone keypad has the added advantage that the English alphabet can also be input to the simputer. However, the issue of mapping regional language characters onto the limited keys of the telephone keypad is as yet unsolved. Increasing the number of keys to accommodate regional language scripts will increase the physical size of the simputer, as well as increase the cost.

The use of handwriting recognition interface is ruled out due to the high-cost of the transducers, even if we ignore the lack of progress in the software for regional language handwriting recognition.

Close in popularity, though not that widespread, is the TV remote control that has popularised the use of certain keys like the 'forward' ('increase') and 'reverse' ('decrease'). Thus, the user-interface of the simputer will have a small display (a few lines at reasonable resolution), a telephone keypad and a few other arrow keys, a speaker and a microphone.

We have barely outlined the essential components of the simputer-interface. A challenging problem in the development of the simputer is the design of a innovative user-interface paradigm that will make the most effective use of the available resources. Such a new paradigm will make the simputer as accessible to the target audience as the point-and-click paradigm, in combination with the desktop metaphor, did to the non-scientific community.

5 Exploring Simputer Applications further

In this section we develop specific applications further to identify requirements at there levels: user-interface, system, and standards.

5.1 Simputer as a telephone

: The simputer should be usable as a basic elephone instrument.

User-interface: Dial a number like a regular telephone. As each key is pressed the number if echoed on the display. The duration of the call can also be displayed.

System requirements: Telephne keypad, modular jack, ringer, speaker, microphone. Internal: tone dialling, nasic telephone electronics. When the Simputer is connected to a wall jack, it should sense the type of connection and configure itself appropriately.

5.2 Simputer for Information access from community information servers

User-Interface: Dial a number using a information services directory which is organized like a normal telephone directory. The information service numbers are differentiated from ordinary telephone numbers by a special key. The numbers are echoed on the display. When the server is contacted, the user is guided thorugh the information by suitable messages.

There are two options:

- text-only: All transactions are text based. the user is prompted by messages. Choices can be made using a few selection keys. There is a default language in which the information is presented and this can be changed in some standard way [2]

[2] Need to standardise several interface issues of the Simputer. These will form the basic look and feel of the Simputer that has to be 'protected'

- Speech-based:

System Requirements: If the simputer is plugged into a telephone line then it is necessary to perform all the services of a dial-up modem: open a dial-up connection to the server using the input number, perform the low-level modem functions as well as the protocol-level functions. Basically, the Simputer needs a built-in modem.

If the simputer is connected to a LAN directly, say through a twisted-pair ethernet then it needs to have abuilt in ethernet card.

Two options of connectivity:

1) Telephone line: advantage is that immediate avaialbility all over the country. Disadvantage is that it ties up telephone lines and so it is not a scalable solution for informationa access. the use of ISDN lines may mitigate the problem. And the technology used by newer modems that allow simultaneous voice and data access may be used to allow multiple users to link ot the same server using a single incoming telephone line.

On plugin, the simputer is a telephone instrument. Regular calls can be made and received. So a basic telephone instrument msut be built into the Simputer. The issue of proper placement of mics and speakers has to be addressed.

When a network service is required, the user dials a special key followed by the number. As soon as the special key is pressed the Simputer has to establish a dial-up connection with a server. In the long run, the dial-up server can have a standard number all over the country, just like railway arrival departure is 133 etc. For the D-Day we can assume that the user has to dial a number that is the service provider's number first to establish the connection. After which individual services can be obtained by dialling appropriate numbers.

2) Ethernet: Advantage is that multiple users can be accesing the server at the same time.

Issues to be addressed:

1) IP address for each simputer. With IPng, it is easy to allocate a unique IP address to every simputer. However, the routing information, and the router requirements will blow up unless new algorithms and hardware evolve to handle this problem. In the meanwhile we can use the dynamic IP address allocation protocols can be used to assign an IP address to the simputer by the local network to which it is plugged in.

2) Currently and in the near future access to LANs will not be as wide spread as telephones. However, it may be possible to wire up STD booths with LANs (similar to the People's internet project in Tamil nadu) so that the individual simputers are connected to a LAn, but the STD boothis connected to the remote networks through telephone lines or ISDN lines.

For the demo next year, (call it D-Day) we may decide to opt for the telphone connection-only Simputer to simplify the design as well as testing of software. We can designate a PErcolat machine to be the 'server' and access it from our home Simputers (currently Pentium PC +modem).

The other possibility is that the Simputer can connect through a Jini interface (java-tone). (don't know how far this technology is viable yet, but we should keep in mind that other interfaces may emerge).

Standardisation needs: The information servers are organized hierarchically. At the panchayat level, distrcit level and so on. the access numbers can have a strcuture similar to the local-call, long-distance call strcuture of the telephone network. This identification of services with numbers has the following advantages:

1) These access number can be standardised, just like Fire is 100, police is 199 etc. For example, railway reservation information server from anywhere in the country can be the same local-call number. Another number dialled from anywhere will land you in the local taluk office server.

2) It removes levels of complexity for the user. instead of connecting to a single server and then seraching for specific information, this approach will allow the user to think of each service as a number that can either be easily remmeberd or conveneiently be looked up in a directory.

3) Since each service is distinct the server-side software can be very compact and modular.

5.3 Simputer for transactions

Even at the targeted cost, individual ownership of the simputer cannot be the basic assumption in designing applications. At best we can assume that everyone will have ready access to a simputer. Hence it is necessary to postulate the individual possession of a smartcard.

5.3.1 Smart cards

The personal data in the simputer world is carried on individual smart cards. Thus the simputer needs a smart card interface.

The initial introduction of smart cards can be expedited if we provide applications that will involve large number of personnel, for example, in a factory. If the simputer supports applications such as worker timings (punch in and punch out), daily wages, etc., then the initial cost of the individual smartcards will be borne by the management and these cards can then be used outside the factory by the employees for other purposes.

(We should plan on using the CSA department and NCORE office as two test sites for debugging these applications)

The smartcard can perform the following functions:

- Voter identity
- Repository of electronic cash- an electronic wallet
- Hold bank access information (complete for depositing money, but incomplete for withdrawal, to be augmented by some means of secure personal identification)

Personal Information carried on a smart card:

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Name
Address
Date of birth
Cyber cash holding
Public key
(Passport information)
(Drivers License information)
(Voter information)
(digital photograph?)
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The loss of a smartcard will mean that the ecash carried in the wallet will be lost. It may be possible for the finder (thief) to spend the ecash, since one of the attractions of ecash is the ability to retain the anonymity of transaction history that is possible with real cash. However the loss will be restricted to the amount of ecash present.

To buy an item from a shop: Use the simputer in the shop. The shopkeeper enters the money due, the buyer listens to the amount to be paid as well as checks the displayed amount. If correct, swipes her smartcard in the simputer, then provides an e-cash PIN to complete the transaction. The e-cash balance in the buyer's smartcard is reduced by the amount of the transaction, and the e-cash balance in the simputer of the shop keeper increases. The shop keeper periodically transfers the ecash balance to his bank. If the simputer fails between transactions, the untransferred ecash may be lost. Alternately, the shopkeeper can use his personnel smart card in a second smart card interface of the Simputer to accumulate the cash.

To give cash to another individual: Both individuals access a simputer, start a smartcard transfer application and swipe their cards in turn after confirming the amount involved and the direction of the transfer.

To deposit ecash into an individual's bank account: The individual connects to a bank through a simputer, gains entry using a PIN, starts a deposit transaction, swipes the smartcard, receives an acknowledgment from the bank and concludes the transaction.

Withdraw e-cash from a bank: This needs more security than deposit transaction for obvious reasons. The secure mechanism for indicating a PIN even while using a third party simputer has to be identified. Otherwise the transaction is similar to the deposit transaction.

To send ecash by email: Technologies exist today that can transfer ecash securely over email. The same technology can be accessed by any user of a simputer mail program. The ecash to be sent is obtained from the smartcard of the sender and is in turn transferred to the smartcard of the recipient. Such a facility will be useful for parents to send money to their kids in hostels, migrant workers to send money home etc. Such a facility will replace the current practice of sending money order through the post office. The MO is the only way by which those who do not have bank accounts can send money to distant places. The MO commission is quite substantial (exact figures needed, though I remember that it is quite significant). if the simputer-smartcard can provide a cheap alternate (operational cost), then this will be a major application.

5.4 Example Communication Scenarios

5.5 Example Information Scenarios

6 Architecture of the simputer

The use of Wintel solutions is immediately ruled out on the basis of cost, and the endless hardware-software upgrade loop that is essential to keep the system in a usable state.

The use of Java environment on a low-cost, low-power RISC processor like the StrongArm is very attractive.

The emerging Jini technology appears to be very promising as the architectural basis for the simputer.

Quotes from the Jini Homepage:

> Jini takes advantage of Java technology. Jini consists of a small amount of Java code in class library form and some conventions to create a "federation" of Java virtual machines on the network, similar to the creation of a community today. Network citizens such as people, devices, data, and applications within this federation are dynamically connected to share information and perform tasks.
>
> "Ericsson is very excited about Jini. We believe that Jini represents a double barreled paradigm shift that reaches beyond the computer industry. The combination of componentized software running on distributed virtual machines and the bold system architecture of Jini will transform and blur the very idea of what computers, networks and applications are." Billy Moon Program Director, New Concepts Ericsson Inc.

Design considerations:

- Security of the transactions
- Robustness of the interface
- help facility

- Easy interface to networks
- INterface to smartcards
- Use international standards where they exist and define new standards

7 Physical design of the simputer

The following factors must be considered in the physical design of the simputer.

- Lightweight
- low power
- Low/easy maintenance
- Tolerance to dust/humidity/heat/vibrations
- Clear visibility in bright outdoor as well as indoor conditions
- Clear audio in crowded and noisy environments
- Facility for privacy

8 Summary and future plans