Design Studies for a Financial Management System for Micro-credit Groups in Rural India

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ABSTRACT

In this paper we describe the design process, results and observations obtained in designing a user interface for managing community-based financial institutions in rural India. The primary users are semi-literate village women from local communities. We present detailed observations from our field visits and the resulting evolution in our design vision. We describe a successful design artifact that is the result of this process, and list several important features that contributed to its success. We conclude with the current state of our work and our plans for the future.

Categories and Subject Descriptors

H.5.2 [**Information Systems**]: Information Interfaces and Presentation—*User Interfaces*

General Terms

Human Factors, Design

Keywords

Literacy, Contextual Design, Rural Development, India, Micro-finance, Design for Illiterate Users

1. INTRODUCTION

1.1 Micro-finance

Micro-finance is defined as the provision of financial services, including credit, loans, savings and insurance, to poor, disadvantaged and otherwise under-privileged members of society (particularly in developing countries) who would otherwise not have access to such facilities. Over the last twenty-five years, since the pioneering work of Muhammad Yunus and the Grameen Bank in Bangladesh, micro-finance has emerged as one of the most effective methods of financial development and poverty alleviation in these communities [3].

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Much of micro-finance in India is built upon the grass-roots infrastructure of a *self help group*(SHG) [10]. SHGs are small village-based groups, consisting of between 10 to 20 members, within which most micro-finance transactions are conducted. We have been working to design a data collection and management system to allow SHGs to more accurately document, manage and track their transactions.

The vast majority of SHGs in India consist exclusively of women. Micro-finance Transactions (including payments, loans, withdrawals, deposits, etc.) usually occur during monthly meetings of the SHG. During these meetings individual members deposit money into a common fund, which is in turn lent to other members at a mutually agreed interest rate, usually for some productive purpose, such as making an investment in their farm or business. Sometimes SHGs also access larger loans from banks and other financial institutions, which is then lent as smaller loans to each member. No collateral is usually required, as the community liability among members of the same village is enough to enforce repayment. In fact repayment rates of these loans are often found to be higher than loans to the general populace.

SHGs also form larger structures by linking with other groups like themselves in their local geographic area. In some cases a set of 20-30 groups will come together to form a *cluster*, and a set of 20-30 clusters will come together to form a *federation* (see figure 1). These larger groupings allow SHGs to transfer funds between groups, and to attract larger sources of investment and institutional capital. SHGs and SHG Federations are often created and a nurtured by a supporting *micro-finance institution* (MFI), often a *non-governmental organization* (NGO). This MFI helps create and support the SHGs, including providing training and capacity building, linkage to external sources of funds, linkages to other SHGs and to the formal banking sector.

Documenting each level of micro-finance transactions is important to track the financial performance and credit of individual members and groups. This allows organizations to better manage their funds, lending to individuals and groups for purposes which will maximize repayment and overall benefit to the community. Moreover, according to strict interpretation of Indian accounting laws, every transaction must be documented and audited at the end of each fiscal year. It often falls to the supporting MFI to carry out these time-consuming tasks.

This proves a huge burden for a number of reasons. First, the raw volume of small transactions that occur in a typical SHG is so high, that data management and reporting be-

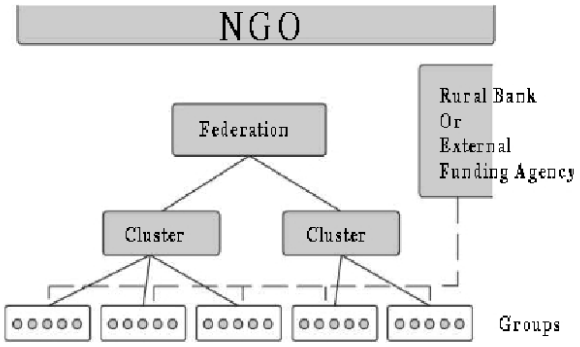

Figure 1: A diagram of the typical organization of an SHG Federation.

come a serious issue. Also, many SHGs operate in far-flung rural areas, making travel cumbersome and costly. This is one of the major overhead costs involved with conducting micro-finance activities and a major reason for its perceived unsustainability.

All of these factors lead to the conclusion that having an integrated top-to-bottom management information system (MIS) for managing grassroots micro-finance operations is an attractive possibility, both from an operational and financial viewpoint. If there was some way to capture local transactions as they occur and have this data transparently and efficiently integrated into the organization's internal accounting system, it would make data collection more accurate, less cumbersome, and potentially cheaper as well. This would allow the entire organisation to become more efficient and allow the end users to obtain more useful information and services.

This problem has been the subject of several recent attempts to introduce digital devices into village meetings to record transactions [8]. However, these efforts have met with mixed results due to poor interface design for local users and poor integration with centralized information systems.

In addressing this problem, one must first recognize several obstacles. Power, connectivity and affordable computing devices are all technical limitations that must be overcome in the design of such a system. Efforts are currently underway to solve some of these problems.

Another issue is the user demographic. Most members of SHG groups in India are uneducated agricultural workers or laborers. The low literacy and educational levels of these users, as well as their unfamiliarity with technology, makes the design of an accessible user interface a challenging task and a crucial factor to the system's success. This is the problem we sought to address in our research studies, by attempting to design a simple, easy to use interface for financial management that would be accessible to these end users.

1.2 Literacy in India

Education and literacy is a pervasive problem in India, particularly in the northern states. The UNESCO Illiteracy Rate Estimate estimated approximately 43% of the adult Indian population to be illiterate in the year 2000 [11]. It estimated that over 54% of women in India are functionally illiterate. UNESCO uses a basic definition of "functional" literacy, where to be literate one should be able to read and write one's own name and simple sentences describing one's activities during the day. In some of the grossly underdeveloped states of northern India, illiteracy rates can hover as high as 70 to 80 percent of the population.

Using UNESCO's estimates of 43% illiteracy in India, a country of approximate one billion people, there are approximately 286 million adult illiterate people in India alone. UNESCO in the same study estimated the world illiteracy rate to be approximately 21% of the adult population, or over 830 million people. Obviously this represents a huge part of the world's population, and cannot be ignored in the quest for the development of accessible, usable interfaces for all of the world's people.

1.3 Structure of the Paper

The rest of the paper is structured as follows: Section 2 describes the idea of *numeric interfaces*, an early idea that served as the genesis for some of our early designs. Section 3 describes our initial field visit to Aurangabad, where we conducted contextual studies and tested some paper prototypes. Section 4 describes a subsequent trip to Madurai, Tamil Nadu, where we conducted more in-depth contextual studies, and tested an initial interactive prototype. In Section 5 we describe our final trip to Madurai, where we conducted an intensive two-month long design study, using techniques such as informal association tests, participatory design and rapid iterative prototyping to arrive at an interface that was reasonably well understood by the end users. We present our final design artifact and some features that we feel contributed to its success. In Section 6 we discuss some related work. In Section 7 we conclude with the current state of our work and our plans for the future.

2. NUMERIC INTERFACES

The initial genesis of this project came when one of our design team members was working with the Self-employed Women Association (SEWA) bank in Ahmedabad, one of the largest and most well-established micro-finance programs in the India, to assess their branch office computing infrastructure and to investigate ways of extending the reach of SEWA's documentation process into villages.

In an early meeting with SEWA group members, we discovered that most of them had little or no formal education. Out of the group of about 25 members, most of whom were very active in group activities, only two or three were literate to any level. Given these circumstances, we were not very confident of being able to develop an effective user interface for this group.

Still, we were curious to learn how the women were able to track their transactions and financial position, and how they were able to manage their personal and group accounts. In response the women heartily said (in the local Gujarati language) "Oh, we can understand numbers fine. We can even do most simple calculations ourselves. It is only text and words we have a lot of difficulty with." This opened our ideas to the idea of numeric literacy, and how we might leverage this and other partial literacies in our designs.

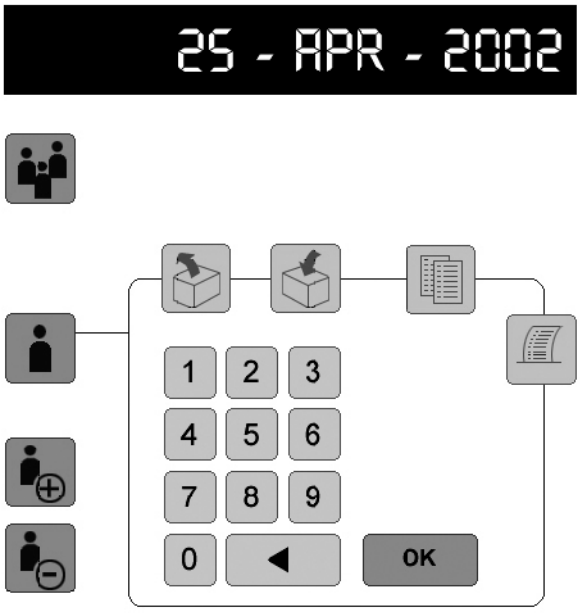

Figure 2: An early keypad-based paper prototype.

3. FIELD VISIT #1: AURANGABAD

Given this motivation, we started by designing paper prototypes. These prototypes ranged from numeric keypad-like devices (see figure 2), to full desktop systems. With these designs in hand, we set out to visit a set of SHGs located near Aurangabad in Maharashtra. These groups had been promoted and supported by an Aurangabad-based NGO named Dilasa, which had originally started its work in the area of watershed development. Dilasa had initiated support for SHGs to respond to the inability of many of its constituents to access loans from banks and through government programs.

Over a two-day period, several of Dilasa's management team and field staff were kind enough to take us to six villages, and visit the SHG members in each village. Our purpose was to assess the user's reactions to our paper prototypes, and also to get a better understanding of local microfinance operations.

3.1 Contextual Studies

Upon entering each village, we were welcomed by the village elders, and all of the members of the local SHG (or SHGs) were assembled by the Dilasa field staff to answer our questions. We were most often seated in chairs in the center of a large circle, the women sitting around us on the ground (see figure 3). This made it a little bit difficult to have an equal exchange of ideas, but as we would soon find out to overcome this limitation we would have to hang around long enough to no longer be "novelties" from the big city.

One of the first things we found upon observation of the local work practices was the central importance of notebooks and ledgers. The women would come to meet us armed with a stack of six or seven notebooks, prepared to display their proficiency and accuracy in recording the local transactions. Obviously the Dilasa staff had been there many times before to train and to assess in their conformance to

Figure 3: Testing paper prototypes in Aurangabad.

the proscribed documentation protocols. There was a set of six to seven ledger formats which were recommended for use by the state government, which Dilasa had adopted and spread among these groups. But some of the ledgers were clearly more important than the others. The most important ledgers included the *cash book*, in which were recorded all of the cash transactions of the group, the *member pass book*, a personal bank book for each member, and a *proceedings book*, for recording SHG rules, announcements and decisions.

These books served as an important shared resource for the SHG. They could be communally viewed and edited during a group meeting, and all of the group members could ensure the accuracy of the entries as they were being made. Storage of the books was an important matter. They were usually stored in one of the group leaders' homes, who would produce them on demand if asked by another member.

Often the transactions were entered during a group meeting by a child of one of the members, someone who regularly attended school and could read and write reasonably well. The child was paid about ten rupees ($0.20) for this service. Often the child did not write the names of each member, but just sequentially noted down the transactions as they occurred. Each of the members had a sequential number in the group, and transactions were conducted in this order. This is also how illiterate and semi-literate members were able to locate their records in the tables. They had memorized the tabular structures (rows for members, columns for different types of transactions) and their sequential position in the table to quickly identify their transaction records.

3.2 Paper Prototypes

Once we had spent some time talking with the local group members, in two villages we proceeded to show them some of the paper prototypes we had developed (see figure 2). Initially the villagers were very confused as to what we were showing them. But once we had explained a little about what we were working on and what our purpose was, things became a lot clearer. In fact the members were very excited that someone was working to build a system to meet their needs.

After the initial confusion, the users were able to understand the intent of the system quite clearly. Most could

identify the numeric keypad and its purpose, as well as most of the icons included in the interface. We were encouraged by these results and excited to continue the design process.

4. FIELD VISIT #2: MADURAI

Armed with this experience, we set out to do more detailed contextual studies and evaluations of potential designs. This time we chose a more mature set of SHGs, located approximately 50 kilometers from Madurai, Tamil Nadu, promoted by an NGO named CCD (Covenant Centre for Development). Dilasa's groups were all less than two years old, which meant they were not completely familiar or mature with regard to difficulties in scale and operation inherent in organizing a large and distributed set of micro-finance groups. CCD, on the other hand, had been working with SHGs for over ten years, and had helped start and nurture over 150 SHGs and 4 SHG federations.

4.1 Contextual Studies

This time we stayed with CCD for a full week, and were able to spend much more time understanding the context, culture and practices of the SHGs. We attended two meetings per day, one in the afternoon and one in the night, for periods of two to three hours each. Between meetings we would review our notes and discuss our observations with the CCD staff, confirming and verifying our impressions. While the local language in Aurangabad was Maharashtrian, a language fairly close to Hindi, which all of us spoke and understood, the local language in Madurai was Tamil, which none of us were conversant in. Therefore we had to rely on CCD staff to translate for us during meetings and interviews.

These SHG members, being used to occasional outsiders visiting their meetings, took much less note of us, and after some initial greetings conducted their meetings much as normal. Here we visited all levels of micro-finance meetings, ranging from individual groups, to clusters to federation, and made detailed observations of the operations and documentation practices.

Each level had its own set of complicated ledgers and forms, especially at the federation and group levels. Most of this was centered around a set of seven ledgers and data formats proscribed by the Tamil Nadu state government for micro-finance groups. Much of the data in these formats was redundant and unnecessary, and we received many complaints about the tediousness and difficulty in maintaining so many overlapping documents. In reality most of these documents should have just been reports generated from a central data source.

In practice there was just one crucial data format in which data was initially entered, from which it was eventually copied into the other ledgers (sometimes inconsistently). For the groups this was a spreadsheet document developed by CCD which was intended to document all of the transactions during a group meeting, as well as the financial position of the group before and after the meeting. For the federation it was the cash book, where data for each transaction was entered in a simple double entry format.

4.1.1 Group Meetings

This time we were able to attend several group meetings on a regular basis, so were able to appreciate more of the local context. Group meetings most often occurred at night, after the day's agricultural labor was completed. Around

Figure 4: One of the villages near Madurai where we conducted early design sessions.

8 or 9 pm, after everyone had eaten and the day's chores had been completed, the group members would assemble in the local square, under the village "street"-light (most of the villages in Tamil Nadu have electricity, although it is unreliable). The local square was a shared community space, and many children, youths and men would also congregate in the center during the meeting. During our visits there were probably more observers than usual.

In these groups we observed many of the same practices as in the Dilasa groups, such as the importance of the notebooks as a shared resource, the importance of the safekeeping and accessibility of the notebooks and the cross-verification capabilities of notebook entries. We also observed again the sequential ordering of members, memorization of tabular formats and ability to read and understand numbers as a common method for illiterate and semi-literate users to understand their accounts and verify that their transactions had been recorded accurately.

In these groups children were also often enlisted as substitute record keepers. Sometimes a local literate man who was not a member of the group would also be hired to perform record keeping, charging about 25 rupees ($0.50) per meeting for the service. We observed that literacy was sometimes much higher here than among groups we had observed in Aurangabad and Gujarat, but that it varied dramatically across social class and caste.

4.2 Prototype Evaluation

For this trip we had decided to develop an interactive prototype based on a standard screen resolution to give us more flexibility in evaluating design alternatives. Since our previous testing we had improved the screen design considerably based on our observations and our improved understanding of local micro-finance operations (see figure 5). We tested the prototype using a laptop machine at several group meetings and one federation meeting.

Several group members, particularly at the federation meeting, were more familiar with technology and had even seen (but not used) computers. One of them had traveled to nearby Pondicherry and visited the M.S. Swaminathan rural tele-centre project [9]. Thus they were more comfortable with the technology, and more confident in the evaluations.

Figure 5: An interactive prototype we tested on our first trip to Madurai.

After some initial hesitation, the members quickly took over the laptop and began to experiment. They were able to quickly understand and use the touch-pad pointing device and use it to navigate the interface.

Some of the members, especially the higher-level federation functionaries, were quite pointed in their feedback about our designs. For example we were informed that our layout only contained five columns, while the spreadsheet format they used in the village meetings required seven. One of the designs that we had developed had a stylish gray-scale color scheme. The women commented that while the design was attractive, Tamilians were fond of colors, particularly yellows and reds, and that some of the users would be illiterate, so that these colors would be helpful to them in identifying relevant parts of the interface.

One interesting occurrence was when a user right-clicked on the screen and the usual menu options appeared. The user and the assembled observers were thrown off by this abrupt occurrence, and deftly moved the mouse to a different area of the screen where they might not disturb the new apparition.

The federation president, herself a tailor, asked us what the cost of our laptop was. When told, she decided that while a single SHG could never afford such a device, the federation might eventually be able to.

5. FIELD VISIT #3: BACK TO MADURAI

Given these early results, we decided to develop some more advanced prototypes and return to the field for an extended period of testing. We scheduled two months in September and October for this purpose.

Upon reaching the field area, we first worked with the CCD staff to organize four groups of volunteer SHG members for our studies. Overall 32 women were included in the evaluations, ranging in age from 19 to 55. 27 of the 32 women made their livelihood as agricultural laborers. The women were organized into four groups of 6-10 women, ranging from more (Group A) to less (Group D) literate. This was to ensure homogeneity in our evaluations. 22 of the 32 women were literate to some degree, at least being able to identify Tamil characters and short Tamil words. All except four of the women (three of them in Group D) could identify single-digit numerals.

5.1 Association Tests

We had been experimenting since the early phases of our design process with the idea of leveraging numbers and numeric literacy to overcome other forms of illiteracy. Our idea was to represent navigation paths in the interface as a sequence of numbers. For example, users would navigate between screens and between screen elements using numeric "shortcuts", so that a particular position in the interface could be quickly reached using a memorized sequence of numbers. This is similar to the kinds of numeric shortcuts available on modern mobile phones.

To use numbers as navigational aids, we had to ensure the users' ability to associate numbers with abstract ideas and actions. To test this we constructed a set of informal tests, where users were given time to memorize associations between different kinds of identifiers and nouns or actions. The identifiers were selected from a set of numbers, icons, and images.

The tests were conducted as follows: users were shown a sequence of images, icons or numbers. We then showed the users an image or told them a word that should be associated with each of them. Users were given as much time as they needed to memorize the relationships. Then, under different contexts and in different spans of time, users were asked to recall the concepts or images associated with particular identifiers.

As a result of these tests we found that abstract signifiers such as numbers were very difficult for the users to relate. Users had a lot of difficulty remembering what concept a number was meant to represent. They were much more successful in associating ideas and actions with highly representational icons (using the terminology of Familiant and Detweiler [1]) that could be somehow visually correlated with the idea they meant to represent. This observation was further corroborated in our interface evaluations and collaborative design exercises.

5.2 Evaluation and Collaborative Design

After gaining this background knowledge, we set out to test some new interactive prototypes we had developed since our last field visit. We situated the sessions at the CCD field office because in the villages we would have attracted undue attention and it would have been difficult to conduct effective sessions. The CCD field office environment was not different than that of a well-equipped local farm, and the users were familiar with the location, so that the context was not much out of the ordinary. Most of the participants lived between 5 and 25 kilometers from the site, and could easily reach the location by bus or jitney.

Over the course of two days we were able to test all four groups on a specific design (or set of designs), conducting two three-hour sessions each day, one with each group. Then over two to three days we would modify the designs based on our observations, and the suggestions and criticisms of the groups. Sometimes we would even change the interface between sessions (or within a session itself), often when we had made some glaring error in the data representation or organization.

In each session we would go through a specified protocol, asking users to identify screen features and perform cer-

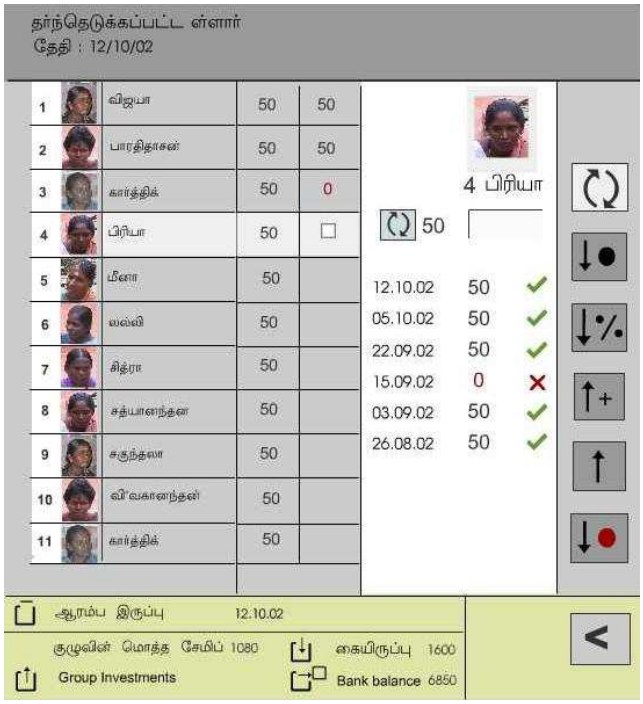

Figure 6: One of our final successful designs.

tain basic tasks. The process was interactive, as the users navigated the interface they could ask questions, make suggestions and recommend improvements (through the CCD staff translator). The users' responses were documented and occasionally recorded on video for transcription and translation.

This process continued for approximately six weeks. We conducted four sessions with each group, for a total eight days of joint design sessions. At the conclusion of this process we had arrived at a design which was reasonably well understood by three of the four groups, with the exception of Group D (consisting of the least literate users). Members of these three groups could interact comfortably with the interface, and were able to complete several simple tasks independently. Even members of Group D had developed some familiarity with the interface and could identify basic screen components and actions associated with specific buttons. A screen-shot of one of our final design prototypes can be seen in figure 6.

5.3 Design Observations

In this section we will describe some features of our final design, and some factors that led to its relative success.

5.3.1 Tabular Data Organization

The users had a practiced knowledge of the organization of their ledgers, especially the tabular data format they used for initial data collection. Repeated entry into this format had led to a deep understanding of its organization and significance. Moreover we observed several times that even illiterate users used the tabular organization to identify important transactions. To leverage this knowledge we focused on maintaining the same kind of tabular data formats and data orderings wherever possible.

5.3.2 Numeric Data Formats

In the course of our initial testing protocols, we found that numeric literacy was more common than other forms of literacy in our users. Basic exposure to number-based formats and tools such as calendars, bus time tables, phones and calculators was also commonly found.

Due to this background we found that numeric data (dates, interest percents, sums, etc.) provided significant cues for overall interface comprehension. From the positioning of numeric data values users were able to understand much of the rest of the interface by its position relative to numbers and tables.

It was important that text, where required, was in the local language, even if users could not fully read it. When text was presented in local language it gave users a greater sense of familiarity and ownership.

5.3.3 Representational Icons

While numeric values as data were well-comprehended, numeric representation of actions and navigation did not work well at all. Evidence of this was given initially by our informal association tests, and later corroborated by our design and evaluation sessions.

Initially we had thought that we could leverage numeric literacy to allow simple, accessible methods for navigation and task execution. However, after our cognitive test results and design iterations it appeared that users were not able to make associations between concepts and abstract numeric identifiers. Therefore we found that navigation or action-based elements were best represented through the judicious use of highly representational identifiers such as pictures or icons.

5.3.4 Iconic Legend

We observed that the meanings of screen elements were most often learned through the effects that they caused. To leverage this experiential learning, we designed an interface feature called an *iconic legend*. An iconic legend is an area of the screen where a set of icons are associated with audio feedback that describes the meaning or result associated with that icon. Pressing a button in the legend has no effect other than generating audio feedback.

We found that through this legend users were able to learn iconic meanings very comfortably through repetition and association, without fear of undesired actions or results. This decreased the amount of guided training and documentation required for understanding of the interface.

5.3.5 Discrete Task Spaces

With the users' limited means of identifying distinct screen elements, we found that minimizing the number of tasks possible at one time made it easier for users to comprehend a screen's overall purpose and structure. We followed a design pattern of *guided linearity*, where users were guided from task to task through a sequence of discrete but consistent screens, each containing a number of well-ordered sub-tasks.

For example, during a SHG Meeting, a number of different types of transactions (savings deposits, loan repayments, loan disbursements) are conducted for each member. We found that limiting each screen to one type of transaction, including a table for sequentially processing each member's individual transaction, proved more successful than a screen from which it was possible to record several different transactions for each user at one time.

5.3.6 Color

We have already discussed how non-textual landmarks such as tables, numbers and icons aided in interface comprehension. Another feature we found useful in this regard was color. Color was used in the screen background to distinguish discrete elements, and used in the foreground to draw attention to aberrant or noteworthy data. For example, the color red was successfully used to represent delinquent payments or negative values. Increased use of color was suggested by the users themselves as a tool to overcome their lack of literacy. This was not surprising considering the broad uses of color prevalent in Tamil media and culture.

5.4 Importance of the Local Context

Staying in the local area and doing design work in the field was a very important part of our design process. By spending over two months there we were able to imbibe local culture, and understand to some degree the pace of life and perspectives of the user community. The users got to know us much better, and were not afraid to give pointed feedback and criticisms about our designs. While this is an important consideration in any design study, it might have been more of a factor due to large differences in culture, environment and perspective between ourselves and the user groups.

6. RELATED WORK

As we mention, several other groups have attempted to develop digital devices to document village micro-finance transactions [8]. However most of these seek to support organization staff members who would travel to villages and collect data. None allow members to record their own data, nor have any of them conducted in-depth design studies to support their interface development.

Huenernfauth [5] and Goetze [2] both discuss accessible interfaces for illiterate users, but neither have conducted actual users studies to support their claims.

The closest work we are aware of is Apple's experiments with rural healthcare workers in Rajasthan almost ten years ago [4]. This work shares many similarities with ours, and there is some definite overlap between our design observations. However, they did not target illiterate and semi-literate users specifically, and their studies took place quite a long time ago. Clearly there is a need for more work in the area before we reach any kind of consensus with regard to design suggestions for these kinds of users.

7. CONCLUSIONS AND FUTURE WORK

In this paper we have presented our experiences seeking to develop an accessible user interface for rural, semi-literate micro-finance group members in India. We have described the resulting design artifact, and some features that we feel have contributed to its success.

Concurrently with this work we have been documenting the operational practices and structure of this micro-finance system, and currently we are working with CCD to design and implement a complete Management Information System (MIS) for one of the SHG federations. We plan to eventually support various modes of data retrieval from individual groups, including transport of paper forms, and continuing our experimentation with novel digital data entry mechanisms.

Through this process we have developed some understanding of the users' work processes, cognitive abilities and interaction preferences. One consistent result has been the importance of physical models and tangible artifacts. Having had experience using ledgers and notebooks, on top of a day-to-day life filled with numerous physical tasks, these users are much more comfortable with artifacts that they can handle and touch, and have some correlation with the notebook-based data entry mechanisms they have become used to. Moreover, these users' current social work practices are built around the idea of shared physical ledger information - which can be communally viewed, exchanged and audited among members of the group. These observations imply that the use of tangible interfaces [6] may have some success for these user groups.

Currently we are working on designing a system that suits these needs. Relying on physical notebook "templates", which provide the context of a typical notebook tabular data entry format, we envision a hybrid PUI (Paper User-Interface) that leverages the users familiarity and social work practices that have built up around paper.

Other researchers have commented on the importance of paper in work environments [7]. We feel that in this way digital data entry would be much more quickly assimilated by these users, and could also be made a cost-effective solution. Moreover this technology can even be made accessible to semi-literate users, leveraging their existing knowledge and work practices. Currently we are exploring the use of a variety of technologies, including bar codes, RFID-augmented paper, and scanning / OCR software in the design and development of this system. We are planning to implement a prototype in the summer of 2003, and evaluate it in the field during the late fall and winter.

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9. ADDITIONAL AUTHORS

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