Paisa Stick: Tangible Currency Interface for Cashless Transactions

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Abstract

Economies around the world are moving towards cashless transactions. The elderly and digitally illiterate seem to have been marginalized by this move. In this paper, we discuss the findings of our research on the problems faced by these users in performing digital transactions. Our findings have helped us in designing a tangible hardware interface that enables these users to perform cashless transactions easily. Our interface is inspired from the existing model of currency transaction from a physical wallet. We have evaluated our design with our target audience through a first-time usability test. In this paper, we present only the user's side of design considerations and evaluation results. These, we believe, may contribute to designing cashless transaction interfaces in an emergent setting.

Author Keywords

India; Tangible currency; Digital Literacy; Emergent Users

ACM Classification Keywords

H.5.2. [User Interfaces] — prototyping, input devices and strategies, graphical user interfaces, K.4.4 [Electronic Commerce]: Payment schemes

Introduction

There is a sustained effort by the Government of India to move to a cashless economy by demonetizing existing 500 and 1000 rupee notes. The elderly and digitally illiterate are the most affected. They lack information about digital payment mechanisms and hence are skeptical about the same. They prefer to use cash despite digital transaction methods being widely available.

This approach to encourage digital transactions seems restrictive in a country like India where internet penetration is low in comparison to countries like Sweden, which have managed to go cashless.

Means of cashless payment

The most common method of transaction in India is cash. Some established shops do accept plastic cards. Mobile wallets have experienced an increase in adoption due to the current move towards cashless economy. This is primarily due to ease of setup on both sides of transaction. Paytm, a prominent m-wallet operator, reported a 250% increase in their transaction value in recent days [8, 1]. This increase is due to the onboarding of local markets which earlier relied largely on cash for their day to day transactions.

Method	Internet (User)	Internet (Vendor)	Bank A/c	Smartphone	User Authentication	Instant Payment
Credit/Debit Card	✗	✓	✓	✗	✓	✓
Cheque	✗	✗	✓	✗	✗	✗
Internet Banking/NEFT	✓	✓	✓	✗	✓	✓
UPI	✓	✓	✓	✓	✓	✓
M-Wallets	✓	✓	✗	✓	✓	✓
Cash	✗	✗	✗	✗	✗	✓

Figure 1: A comparison of available payment options

An m-wallet may be a convenient option for low value transactions but it requires a complex conceptual model. This poses adoption difficulties for the digitally illiterate users.

Figure 1 indicates that the transition from cash based to cashless economy requires significant efforts in the way how people perceive money. This is because cash involves lesser technical competence, minimum understanding of banking mechanisms, provides instant value and is universally accepted.

Design Brief

To enable the elderly and digitally illiterate to adapt to cashless economy in India.

Design Process

User Studies
A few months back, we conducted an extensive user study on cashless credit- based transactions in one city, one small town and four villages in India. We studied spending patterns and the general attitude of the digitally illiterate towards finance micromanagement. Contextual inquiries were conducted on 61 people.

Recently, after a month of demonetization in India, we conducted a follow-up round of contextual inquiry to understand the response of people towards cashless transactions. The target audience for this study was chosen to be working women, senior citizens, and illiterate people who buy from street shops that accept payment via cash or m-wallets. The key questions in our contextual inquiry were, "How is the conceptual model of money different for these users? What is their perception of digital payment methods? What design
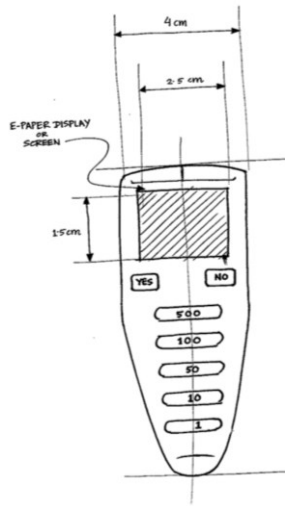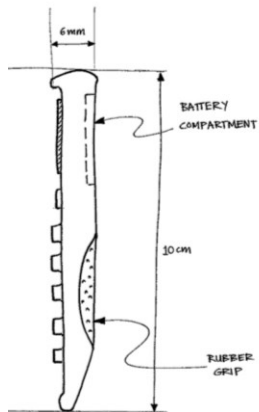
Figure 2: Concept Sketch (Front)

Figure 3: Concept Sketch (Side)

interventions can improve their adoption of digital means of transaction?"

This study indicated that our user group refrains from using digital technologies that enable cashless transactions. The reasons for this reluctance were:

- Lack of knowledge of how digital technology works, therefore lack of trust
- Lack of consumer privacy
- Fear of getting hacked/looted
- Lack of awareness about the scope of usage of plastic cards and third party finance handling applications
- Absence of bank accounts (21% of the world's unbanked population lives in India [3] and only 53% of Indians have a bank account (2014 data))
- Unavailability of smartphones with active internet connection (Only 12% of old age users (35+ years) own or use a smartphone with internet [4])
- Resistance to change

Some of the user statements were, "Give me something that I can relate to (analogous to wallet and physical currency)", "Show me what I spend, spare me the hassle of carrying change"," I don't want to learn to use a smartphone, it is too complex", "I don't have an active internet connection", "Illiterate people are scared of using touch screen devices", "Do not dump too much information on me", "I do not have cash", "My son/daughter does the shopping, I do not spend", "I do not trust the digital transactions as I do not get to see the real-time cash exchange".

Based on these insights from the behavior of our user group, we came up with possible design ideas for a

payment system for the elderly. Our target users wanted a design that:

- gives them something that they can relate to (analogous to wallet and currency)
- gives a representation of the amount spent
- spares them the hassle of carrying change
- does not require them learning to use a smartphone
- does not require an active internet connection
- does not increase the cognitive load on the users
- is transparent and keeps the user informed at all times

Considering the above, we performed a goal setting exercise using the "usability goals setting tool" created by Joshi [5]. The tool helped us in defining the key goals for our interface design and in evaluating the same.

Prototype Development

Concept
We created a cashless transaction experience, analogous to spending currency notes from a physical wallet, to ensure easy user onboarding. After the contextual inquiry, we incorporated a 5 button layout to represent the major denominations in Indian currency (i.e. 500, 100, 50, 10, and 1) and 2 soft buttons, namely 'yes' and 'no', to make decisions (Figure 2,3). Our device, the Paisa Stick, works on the principle of offline money.

The idea of offline money was inspired by the physical offline password keepers [6].

To visually distinguish the buttons, we color-coded them. In order to pay an amount, say Rs. 585, the user

can press buttons labeled 500 once, 50 once, 10 thrice and 1 five times. Alternatively, if he decides to pay a rounded-up amount say Rs. 600, he gets back a balance amount of Rs. 15. We also incorporated a small e-paper display to give real-time feedback of the wallet status in our design.

The Paisa Stick is operated on a small coin-cell battery. It is lightweight and has the dimensions of an average remote control (4cm x 10cm x 0.6cm). The small size enables the device to be carried around in a pocket and to be accessorized as a pendant or a key ring.

Working

To Pay

Once the shopkeeper tells the billed amount for the purchase, the buyer (our user) punches in the amount by pressing the denomination buttons accordingly in his Paisa Stick and pays for his purchase. To accept payment, the shopkeeper calls on a toll-free number for which his phone number acts as a unique identification. The shopkeeper enters the amount to be received, which opens a payment gateway. The customer's device, when placed close to the mobile phone, transmits the payment data through encrypted DTMF (Dual Tone Multi Frequency) tones. The IVR recognizes these DTMF tones and accepts the payment. In turn, the Paisa Stick receives an acknowledgment and updates the device balance. This is demonstrated as a user-scenario in Figure 4 and also in the submitted video.
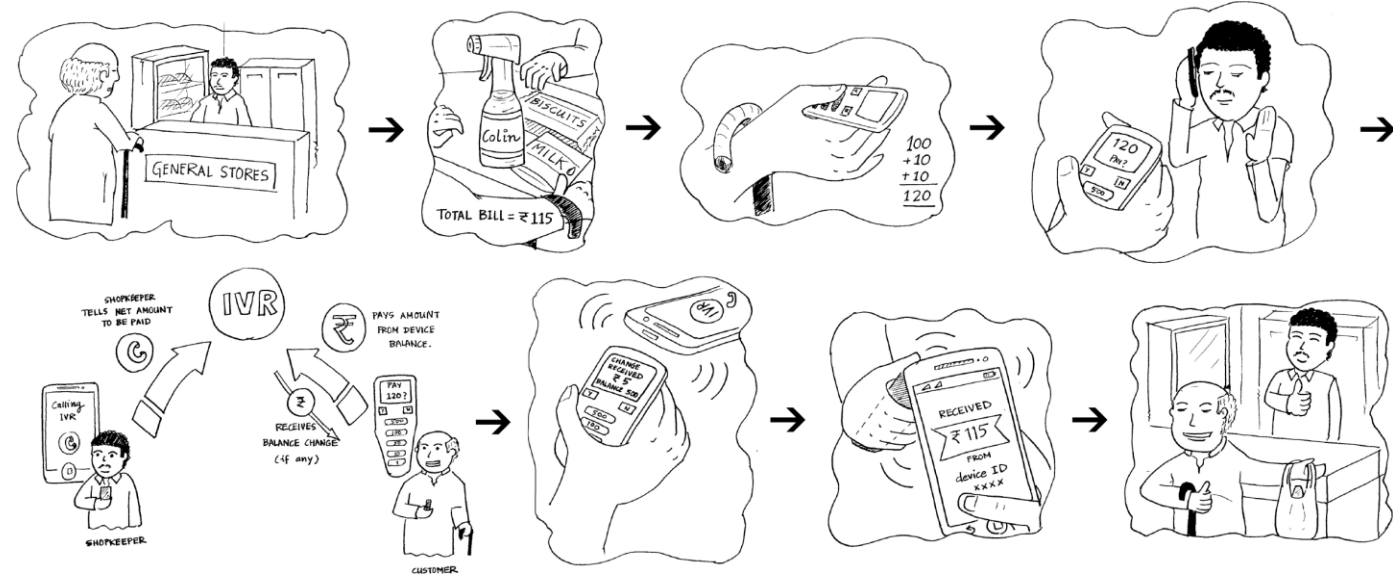

Figure 4: User Scenario

Figure 5: Paper Mock ups

Figure 6: Low Fidelity Hardware Prototype

The screen also displays the QR code for the amount in current transaction. The shopkeeper can scan it if he owns a smartphone, and then transmit the acknowledgment with the balance amount (if any) using DTMF. This makes the device compatible with existing m-wallet applications. The QR codes are stored in the device memory. DTMF tones are better than NFC technology as many vendors in this context may not own phones which have NFC capability or a built-in camera; also having an NFC hardware with the user would substantially increase the cost of the device.

To Add Money
The process of adding money to the Paisa Stick is similar to recharging a prepaid phone. Users can recharge it at local shops in exchange for cash/cheque. The digitally literate members of the family can do the same for them via online payment methods. In the event of losing the device, it can be blocked from further use. The device balance can be transferred to a new device after authentication of user credentials. Hence, no monetary loss will occur.

Error Correction & Recovery
There is no loss of money due to entry error in Paisa Stick. If the user enters an amount lesser than the actual amount due (according to the purchase receipt given by the shopkeeper), then he can always perform another transaction. When the amount entered is more than the total amount to be paid, the correct balance amount is automatically retrieved and corresponding feedback is given on the e-paper display.

Paper prototyping
The initial designs of our concept were printed on hard cardboard to create physical mockups (Figure 5). These

were then used to evaluate the ergonomics of our design and its usability. These tests helped us understand the first impressions of the design. Through these tests we received feedback such as inclusion of regional languages, covers, numeric keypad, and waterproofing.

Low Fidelity Hardware Prototyping
Considering the feedback we received, we created hardware prototypes using Arduino Nano and an off-the-shelf OLED display (Figure 6). These prototypes simulate the device behavior. To evaluate these, a usability test was again conducted.

Usability Testing

We tested the Paisa-Stick against five key goals:

1. The users should be able to understand how to pay an amount using any combination of the five buttons (payment).
2. The user should be able to read the device balance and transaction messages clearly (legible display).
3. The user should be able to set his own password to lock the device (security).
4. The user should be able to unlock a locked device using his password (security).
5. The user should get constant feedback while entering the amount for any transaction (feedback).

We gave 9 users 5 tasks to perform. We gave them a score of 2 if they were able to perform the task without any help, 1 if they were able to complete it only with help and 0 if they were not able to complete the task at all (Figure 7).

Tasks	User 1	User 2	User 3	User 4	User 5	User 6	User 7	User 8	User 9	Avg. Task Score
Pay an amount of Rs. 205 using the Paisa Stick	2	1	1	2	2	2	2	1	1	1.56
Read out loud the device balance before and after the transaction	2	2	2	2	1	2	2	1	2	1.78
Set your own device lock password	1	1	1	1	0	1	1	0	0	0.67
Unlock the device using your password	1	1	0	1	0	2	0	0	0	0.58
Enter the amount Rs. 585 on the Paisa Stick correctly in the first attempt	2	1	1	2	1	2	2	1	1	1.44

Figure 7: Results of Usability Tests

We evaluated the Paisa Stick on the above scores. If the average score of a task ranges from 1.5 to 2, then the corresponding goal is successfully achieved; 1 to 1.5, then the corresponding goal is partially achieved and the feature needs to be explained in a better way; 0 to 1, the corresponding goal is not achieved and the feature is not suited for our target user. In our usability evaluation, we found that the features for payment and legible display could be used with ease, the constant feedback feature was a partial success and the security feature failed to work for some users. The security feature needs to be made more adaptable.

Conclusion

In this study, we used contextual inquiry, goal setting, first time usability test and think aloud method to identify problems faced during cashless transactions by the elderly and digitally illiterate. Our primary and secondary research helped us understand the adoption

issues faced in digital payment methods. The proposed interface addresses these issues by simulating the experience of using currency notes from a physical wallet. Creating multiple prototypes and getting feedback from the target users helped us validate our key goals. In our usability tests, 6 out of 9 participants found this interface useful and easily adaptable. In future, we plan to test a functional prototype of Paisa Stick in an in-situ transaction location with its attendant distractions.

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