

TOWARDS A DIGITAL MONEY STRUCTURE FOR ILLITERATE USERS

Research in Progress

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Abstract

In developing countries, although money is becoming digital in the form of mobile money, it is not easily used by millions of illiterate users in their everyday transactions. Digitization of material money thus poses a challenge to many users. Existing mobile money systems and platforms represent money in terms of simple numbers, like 13, 50, 0.78, 23.64, 80 etc. This way of money representation is almost unusable by illiterate users, unless they depend on others' help. The literature has overlooked the different metadata inscribed on material money (like icons or images, color, security means, and serial numbers etc). However, these metadata enable illiterate users to identify different currency notes. The material properties of money bills also enable illiterates do simple maths like addition, subtraction, division, and counting. However, current mobile money solutions have not considered money bill's metadata. Such absence of metadata made money bill identification and transactions difficult for illiterates. The work described in this paper uses the theory of digital objects and theory of non-material technological objects and presents a theoretical presentation for the structure of digital money, to be used in digital ecosystem.

Keywords: Mobile money, digital money, digital money structure, illiterate users, rural informatics

1 Introduction

A growing body of literature indicates that money is changing its form - from material into digital one. However, the development of mobile technologies compounded with a lack of financial services to the rural communities force people of developing countries to start linking their financial behaviours with mobile financial services in new and innovative ways. For example, the success of mobile money systems, like GCASH in Philippines and M-PESA in Kenya, clearly indicates how the form of money is changing. This revolution signifies a transformation in which money gradually become less material and increasingly digital (Muhammad, 2011; OECD, 2002), confirming a trend that societies are becoming cashless (Garcia-Swartz et al., 2006). Moreover, this transformation in the form of money brings with it the potential for universal inclusiveness that has been missing in the past (Wladawsky-Berger et al., 2013) and it could prove to be one of the most transformative technologies of all time. Indeed, mobile digital money is coming, over time, to every individual in every corner of the world. With this move and transformation regarding the form of money, the need for mobile money systems to manage everyday transactions and practices arise (Olsen et al., 2012). Mobile money systems with a primary, but not exclusive, emphasis on use by illiterate individuals are the focus of this paper. Here, the term mobile money and/or digital money refer to money stored, transferred, or transacted through mobile devices.

Anthropologists like (Maurer, 2006) argue the term money includes assets like gold, cash, cheque, credit and debit cards, cattle, silver, or any useful material. However in this paper, we refer exclusively to cash and study how the digitization process affects its material properties and its structure. Money is simply information or data that circulate in the economy (Byler, 2004; Gellion, 1999; Kendall et al., 2012; Mas and Sullivan, 2012). The significance of money is in its value representation, which enable individuals convert what they have into anything they need. Furthermore, a digital representation of money enable users store and mobilize money digitally in ways which were not readily available in the past, opening up many opportunities. However, with such digitization of material money bills entering into private life, there is a serious intellectual void with regards to the nature of everyday money practices and format of digital money in digital ecosystem.

Existing studies of money digitization in the form of mobile money focus on security, adoption, and development impact assessment. Moreover existing mobile money platforms and solutions like M-PESA of Kenya and GCASH of Philippines have some shortcomings. Firstly, money is represented digitally as a continuous positive rational number, such as 0.12 Euros, 3980 Euros, 1.56 Euros, etc. However, such money representation is not easily understood and operated by illiterates¹ of developing countries. Illiterates who cannot understand numbers, who identify money bills through color and icons on them face a huge challenge to use mobile money solutions, unless they depend on the help of others or convert their digital money into cash at agents. Secondly, existing studies assumed money is rational, single, objective, and impersonal. However, practical field observations and a review of the literature in the areas of anthropology of money, sociology of money, and behavioural economics reveal that money is personal, heterogeneous, and gets its meaning from the social interaction among people (Zelizer, 1994, 1996).

¹ In this paper the term illiterates/illiterate user refer to those categories of people who cannot read and write any numbers and texts and cannot enter any data or information into computing devices. However, they do many amusing mathematical computation in their mind without writing on a paper or without entering into computing devices. Thus, they are illiterate functionally.

In cash economy, we have money bills with different exchange value (5 Euros, 10 Euros, 50 Euros, etc.), each bill coming with different color, images, and size. Accordingly, in this paper, the research question being addressed is *what structure or form should digital money take?* The paper is organized as follows: section two describes the research design; section three is about everyday money practices of individuals, section four is about the structure of material money (cash); section five describes software modules as the structure of digital money; section six is about limitation of the paper; and section seven concludes the paper.

2 Research Design

This paper is part of a bigger research project we are working on. The ethnographic field observation and research we made in 2010 and 2012 is the motivation to write this paper. In addition to the field study, we have reviewed literature from economics, sociology, anthropology, Information Communication Technology for Development (ICT4D), and ubiquitous computing. In order to conceptualize the structure of digital money, we have used two theories: the theory of digital objects and theory of non-material technological objects as a lens. These theories enable us to identify the characteristic feature of digital objects and how components of the digital objects can be represented, stored, and displayed through material technological devices.

3 Everyday Money Practices of Individuals

Understanding everyday lived experiences of individuals about money is informative towards conceptualizing structure of digital money. This refers to the understanding of how people receive, give, pay, differentiate, spend, and treat money in the context of their social, religious, and cultural contexts. Reviewing socio-anthropological literatures about money and individuals' everyday money practices reveal that individuals personalize money based on its source (Douglas, 1967) and assign different social values based on the source and purpose of money. For example, money received as prize for an outstanding college performance is treated differently than money received as regular salary, as the former has social value attached to it than the mere economic value of the later. Its use also differs. For example, (Thomas and Florian, 1958) remarked that a peasant who set a sum aside for a designated purpose, and then needed some money for a different purpose, would prefer to borrow "even under very difficult conditions, rather than touch that sum." On top of such specific use of some money types, individuals also categorize money based on different criteria like earned money (of which the recipient somehow morally deserves) and unearned money (derived from some kind of windfall or theft). Such monies are also treated differently, even when the sums are identical (Hutchinson, 1992; Kahneman and Amos, 1982; Katznelson 1997; Lea et al., 1987; Singh, 1998; Thaler, 1985; Zelizer, 1994, 1997).

While the state and the law worked to obtain single national currency, people actively create different monies and distinguish them by using different techniques and tools. For example, rural people use jars, envelopes, or boxes to distinguish monies physically, while some of them stash monies in stockings or under mattresses and floorboards. Alternatively, urban families rely on a variety of outside institutions to save and differentiate their monies, from regular or postal savings banks, school banks to insurance companies, mutual-aid societies, and building and loan associations. In many cases, this was not just accumulation of homogeneous capital, but differentiated savings Zelizer (1994).

The work of (Mesfin, 2010) also indicates that under some contexts individuals also reject/refuse to accept some payments and gifts for different reasons like: if the gift is immaterial, if the money is 'dirty' (stolen money), if the purpose of the gift money is not known, and if the contexts under which such gifts are made are against ethical issues. This indicates that analyzing the complex social life people make with money talks about the kind of money systems we need to think of about in the

future. Thus the classic economic assumption and function of money as a single “general-purpose” is unsuitably narrow and does not reflect the real practice of individuals in their private life context. Moreover, this is the missing element in the mobile money information system literature. So what kind of digital money structure enables people to perform the above cultural practices in the digital ecosystem?

4 Structure of Material Money

Any monetary system, digital or material, must be based on trust Byler (2004). One accepts your cash, because he/she trusts you and hopes he/she can be able to use it somewhere else. The sources of trust vary from people to people. For example, illiterates validate and develop trust on money bills through the images/icons inscribed on them and through color of money bills. The existence of such metadata on money bills boosts the confidence of illiterates to identify and use the bills without concern.

Material money objects have characteristics that describe and distinguish it from other objects. These identifying characteristics include: color, size², images and icons, security tools, national identifier, serial number, and numbers indicating economic value, and monetary governing body. Figure 1 shows the metadata of two Ethiopian money bills.

These features serve the following purposes:

- *Images or icons:* The icons or images on money bills usually serve the role of collective national values or to commemorate elite individuals and their sacrifice for the nation (Hymans 2004). For example, Ethiopian money bills have pictures of a coffee plant, a farmer, a map of Ethiopia, historical buildings, etc to indicate that agriculture is the base of the economy. In Ethiopia, the icons and images inscribed on money bills enable illiterate users to identify money bills.
- *Security tools:* These are features inscribed on money bills to identify real money from forgeries. The problem is that, when the bills get old, these features usually fade away and may not be visible, which makes differentiating forgery from valid money bills difficult.
- *Serial numbers:* These have also a very important role. When all or parts of these numbers are lost (faded away), individuals do not accept such bills. Such money bills have to be taken to banks for replacement. Otherwise, they become worthless, as people, particularly illiterates, will not accept them for change during transaction.
- *National identifier:* In the case of Ethiopia, this is written in both English and Amharic and identifies the legal issuer (governor).
- *Color:* All Ethiopian money bills are color-coded, which enable illiterates to distinguish between different money bills. Color and images on money bills are thus used for counting and computational purposes. For example, illiterate individuals know the sum of 10 birr³ and 5 birr will give 15 birr and yet do not know how to write these numbers. When they are also asked to pickup money bills of say 50 birr from a lump sum of money bills with different denominations, they easily identify these through colour. Thus, it could be said that color of money bills is a means to identify them.

² Unlike US dollars, Ethiopian money bills have different size and colour, which enable illiterates to identify money bills

³ Birr is the Ethiopian currency. It has denominations of 1, 5, 10, 50, and 100.



Figure 1: characteristic feature of Ethiopian money bills of five and ten birr

- *Economic value*: These are numbers written with Arabic numerals: 1 birr, 5 birr, 10 birr, 50 birr, and 100 birr, as well as in the Ethiopian numbering systems and the Amharic language.

The material nature of money bills also has an added value for illiterate and visually impaired people. Illiterate people make simple mathematical computations (additions, subtractions, multiplication, and divisions) by moving money bills here and there as they cannot accomplish these through writing numbers on paper or calculating machines. For example, in order to make payment or receive payments people count money bills and in order to count them, people usually sort and arrange according to the denominations (from smallest money bills to the largest) and then hold the stack in one hand and count with the other hand.

Based on the uses of the metadata of money bills and review of everyday money practices of individuals discussed in section three, the structure of digital money and the systems that handle digital money need to support these practices. However, current platform solutions and digital money representations do not consider everyday money practices of individuals. This challenges the usability of digital money for social purposes; moreover, it is not easily used by illiterates. The following section discusses one possible ways to address the challenge.

5 Software Modules as Digital Money Structure

When the form of money change from its material into digital form, it is important to sustain its functions and identity (Byler, 2004; Gellion, 1999; Kendell et al., 2012; Mas and Sullivan, 2012). However, from the existing mobile money literature, digital money is simply represented by positive rational numbers like 0.87, 29.65, 10, 120 birr etc., leaving out metadata like color, serial number, security means, images and icons. Such omission of metadata and numeric representation of money poses challenge to its use by illiterates. With money digitization, such individuals depend on the goodwill, honesty and kindness of others to help them use digital money. However, given the role of money in individuals' daily life, such dependence on others places such people at a huge disadvantage. To address this challenge, this paper uses the theory of digital objects (Kallinikos et al., 2010, 2013) and the theory of non-material technological objects (Faulkner and Runde, 2010, 2013) as a guiding lens.

With the development of pervasive digital technologies and their programming interfaces, it is now possible to incorporate digital capabilities and the properties of digital objects, such as reprogrammable functionality, tractability, editable, interactivity (Kallinikos et al., 2013; Yoo, 2010; Yoo et al., 2012) into objects that had material presence previously. These capabilities of digital objects enable designers to create and incorporate experiences into digital objects and to expand existing physical materiality by entangling it with software-based digital capabilities (Kallinikos et al.,

2013; Yoo, 2010). This enables individuals to perform everyday money practices using money in its digital form. Thus, the practices of money tagging, labelling, personalizing, and decorating can be still accommodated.

5.1 Theory of Digital Objects

Any digital object has characteristics or attributes which affect its appearance, behaviour, quality, and usability Kallinikos et al., (2010, 2013) and can be grouped into categories such as content, context (metadata), appearance (e.g. layout, color), behaviour (e.g. interaction, functionality) and structure (e.g. pagination, sections). These properties enable digital objects to remain accessible and meaningful. For example, the color, images and/or icons on money give the look and feel of money to users and its issuer. As these properties enhance money's usability by illiterates and nations are interested in maintaining their identity through the icons present on money bills, during money digitization, care should be taken in deciding which properties to maintain and which to eliminate.

According to the theory of digital objects, digitization doesn't mean elimination of the metadata of objects. Rather it looks at possibilities to sustain the identity, operation, and structure of digital objects through technology. As regards money, the metadata we identified in section four should not be eliminated, unlike the case in today's digital money solutions. As discussed by Kallinikos et al.; (2010, 2013), all digital objects share common characteristics, summarized in Table 1 and we mapped them into digital money in the last column of the table.

Table 1: characteristics of digital objects and its relation to digital money structure

Characteristics	Description of the Characteristics	Remark (how the characteristic can relate to digital money structure)
Editable	Digital objects should be systematically editable. This could be in the form of adding, deleting, or rearranging elements the object is made of.	Governments might be interested to edit/change the color of money bills, their security mechanism, images, etc. For example, the government of Ethiopia modified the map of the country on money bills, after Eritrea gained its independence.
Interactive	Digital objects provide a way so that individuals can activate functions embedded in the object or explore the arrangement of information items underlying it and the services it mediates.	This property helps individuals explore different components of digital money, e.g. color, numbers that show economic values, images/icons, serial numbers, and security means. Furthermore, this feature is also important to distinguish among money based on sources and purposes, as discussed in section three.
Open and programmable	Digital objects are possible to access and to modify by means of other digital objects (usually software programs), as when picture editing software is used to bring changes to digital images.	This refers to the use of software programs to govern and manipulate digital money bills. This enables individuals to integrate and glue the elements of digital money together, and thus manage digital money in their everyday life.
Distributable	Digital objects are border-less and can be used anywhere.	This is not the case when it comes to material money. Money's use is limited to a country's geographic territory. When money crosses a country's territory, it cannot be used as it is, and needs to be converted. Thus, the kind of money bills needs to be determined technically through the use of software systems.

From this we understand that digital money is not simply digital, it has a double mode of existence, being composed of arranged contents (metadata) they mediate, and the operations through which the metadata is assembled and maintained. Moreover, Yoo (2010) has identified additional properties of digital objects that can also be applicable to digital money such as programmability, sensibility, communicability, traceability, and associability⁴. Some of these features can also be embedded into digital money systems.

5.2 Theory of Non-material Digital Objects

Faulkner and Runde (2010, 2013) have also identified the below characteristic features of digital objects, which we map, in the last column of Table 2, to their digital money object counterparts.

Table 2: characteristics of technological digital objects and its relation to digital money structure

Feature of technological objects	Description of the characteristics	Remark (how these characteristics can be related to digital money)
Continuity for long time	This characteristic feature states that digital objects in general can and do exist for long period of time than the event performed through them.	Money by its very nature circulates in the economy for long period of time. Similarly, digital money should be capable of circulating in the economy.
Objects are structured	This characteristic feature indicates an object is composed of a number of distinct parts that are organized or arranged in some way. Moreover, the constituent parts of any object are themselves objects in their own right.	As stated earlier in this document digital money objects should consist of some components. This might be the icons, economic money value, color, and others.
Use by community	Digital objects should enable communities to use them in order to fulfil their interests	Similar to material money, digital money should enable individuals perform whatever they perform with material money.
Recombine-ability	This refers to the merging or blending together of different objects, or parts of those objects, to produce something new, something that is more than the sum of its constituent parts.	As each money bills has its own unique and distinctive components (color, images etc), there should be a way to tie them together and form digital money object.

According to Faulkner and Runde (2010, 2013), digital money can be considered as a technological object with a form and function, which identify its identity. The structure or form of digital money should make it capable to perform its functions without being constrained by its digital nature. Faulkner and Runde claimed that an object has a particular technical identity within the community, if (1) it has got its associated function(s) assigned, and (2) its structure enables it to perform that function.

According to these criteria, the structure of digital money should be in such a way that it enables individuals perform both formal and informal transactions discussed in section three of this paper. Both form and structure can be used to identify digital money and thus we claim digital money bills

⁴ Interested individuals can read the details from his paper entitled as Computing in everyday life: A call for research for research on experiential computing. *MIS Quarterly Vol. 34 No. 2, pp. 213-231*

sustain money metadata. Failure to incorporate these metadata into the structure of digital money affects its usability and acceptability by illiterates.

In information systems, the concept of modularization has a good implication for innovation of digital products or services. For example, modular architecture, the degree to which a system can be decomposed into independent components that can be recombined, has an advantage of designing digital objects that can be editable or updatable without affecting other related components Yoo et al., (2010). This concept offers an effective way to reduce complexity and to increase flexibility in design of digital money by decomposing the metadata of money into loosely coupled components interconnected through predefined interfaces. This enables to sustain metadata of money in its digital form Kallinikos et al., (2013) and be treated independently.

Treating metadata of money independently as software modules is closely related with the granular constitution of digital objects Faulkner and Runde (2010, 2013). A digital object is granular in a sense that the items which it is made of are separable and clearly differentiated from other items. As the result the items of digital objects can be manipulated (modified, deleted, added) independently of one another and brought to various configurations. This is to say that the attributes we ascribe to digital money objects can be mapped into software modules. Assembling and integrating the different modules of money's metadata objects in some way can give us a larger digital money object. Thus, digital money can be considered as an 'integration of different software modules' that stands for money's metadata (Figure 2). Such modularized approach can add a visual appearance to digital money and provide visual aid for illiterates to distinguish money bills.

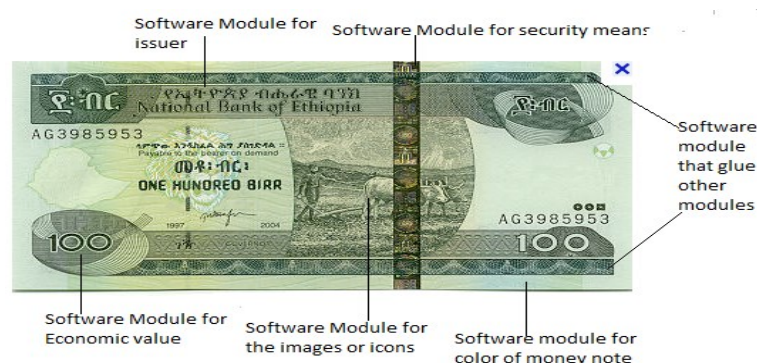


Figure 2: software modules as digital money objects

6 Limitations

The case study on which the paper is based was done in Ethiopia, so, any generalisation to other countries with different money characteristics and practices has to be done with care. Moreover, our analysis only targets one potential category of users for whom digital money is a challenge (illiterate users); generalisations to other categories of excluded users, such as the visually impaired, warrants further study.

7 Conclusion

In order to design mobile money systems, one has to understand the nature and characteristic feature of digital money that the system handles. In this paper, we have tried to address this issue by elaborating what should be the structure of digital money. Accordingly we have shown how software modules can be used to represent the different information elements of money bills. By doing this, we hope the paper incites much needed further study in this area.

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