A Micropayment Enabled Webshop for Virtual Items

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ABSTRACT
In this paper we will give an overview of a webshop for digital items in a virtual world that supports mobile micropayments. Virtual environments are a computer generated imitation of the real world and allow their residents to interact with each other, and contribute digital content. In-world shops for trading with this content suffers from several drawbacks and a possible solution are external platforms also known as webshops. The price of the traded virtual items is in general very small if compared to “real world” products and therefore alternative payment schemes are needed. In this paper we describe the combination of the virtual world of Second Life and an external selling plattform. For simplification we have used an existing webshop framework and added the required functionality to offer virtual items. To add items to the webshop and deliver purchases, an in-world robot that acts as gateway to the virtual environment has been implemented. Further, a mobile micropayment has been employed to top up the webshop account and allow in-world payments for the external webshop. The implementation offers an easy way to buy virtual objects and skip the step of exchanging real money into virtual money. All listed items in the webshop remain inside the virtual environment and are delivered upon a request to an in-world robot. The presented webshop combines the benefit of searching, filtering, and comparing objects combined with in-world payments. It is an easy-to-use platform to trade digital content in a virtual world without revealing sensitive and personal information like credit card numbers.

General Terms
Virtual Worlds, Webshop, Mobile Micropayments, Second Life, Linden Labs

1. INTRODUCTION

Upcoming broadband connections and the rapid progress of technology facilitated the advent of the 3D cyberspace referred to as virtual worlds. In contrast to computer games these virtual worlds do not only offer fun and entertainment but only try to map the “real” world into a “virtual” world. Sivan introduced four formal criterions for a successful virtual world, [16]. First, a virtual world simulates the real world and adds additional features to this environment. The residents of the virtual world can move around, fly, or even teleport to different places, do not need sleep, and can be impersonated. Second, just like in existing social networks, e.g. Facebook or MySpace, residents can interact with others via different communication channels and maintain friends lists to share personal information with them. Third, participating users can create and build content in the virtual environment. This involves simple textures for clothing or even complex buildings like cars or houses. Finally, residents should be able to sell, buy, or even trade with these objects which implies a working economy in the virtual world that bases on real currency.

There are two different ways for residents to buy objects – either in in-world shops or in external webshops accessed by a web browser. The benefit of in-world shops is the ease of use because users can buy the items from other users and do not need to leave the virtual environment. On the other hand external webshops offer well known mechanisms to search for objects, filter, or compare them and is not limited to one seller. In case of a purchase all bought items are delivered directly to the specified in-world resident. The value of the offered items and objects in the virtual world or in the webshop is either determined by its creators or the market. This depends on the effort of creation and the uniqueness or availability within the virtual world. Although the prices are quoted in a virtual currency, e.g. L$ for Second Life, it is related to a real currency like Euro or US Dollar. There are several platforms to “buy” this virtual currency but all of them suffer from the lack of anonymity due to credit cards or debit cards used for the payments.

In this paper we present an approach to buy objects in an external webshop and pay directly by mobile phone. This approach combines the exchange of real currency to virtual currency with the actual purchase.

The rest of the paper is organised as follows. In Section 2 we will give an introduction to virtual worlds in general and describe the used terminology. We point out the need for
serving platforms in virtual worlds and introduced possible payment systems. Section 3 points out the requirements that are used for the a micropayment enabled webshop from a user-centric point of view. Basing on these requirements Section 4 gives a rough overview of the design of the webshop with focus on the architecture. Finally, Section 5 concludes the paper and gives an overview of future work.

2. THE METAVERSE
The term Metaverse was introduced back in 1992 by Neil Stephenson in the novel “Snow Crash”, [17]. In general, these virtual environments are computer generated worlds where residents, referred to as avatars, can interact with each other. If compared to “Massively Multiplayer Online Games”, [18], a virtual world is not a game although it uses the same technologies for the representation but more a social network with three dimensions. The development of virtual worlds is still in an early stage but they become more and more popular for users, [3]. Today’s most successful virtual world is Second Life with more than 700 thousand unique users per month in the fourth quarter of 2009 [7]. Besides proprietary virtual worlds like Second Life there are also free and open source virtual worlds like the Open Simulator project4 or Project Wonderland². In contrast to Second Life that is maintained by a company called Linden Labs2, all open source initiatives are developed by the community. Despite some promising approaches for currency in open source based virtual worlds the main drawback of these projects is the missing financial responsibility of the open source community. The presented approach for the webshop is suitable even for virtual worlds without currency but due to simplification we focus on Second Life for the remainder of this paper. Second Life has a server-client architecture that requires a special viewer software to participate. In 2007 Linden Labs, the company behind Second Life, released the communication protocol between client and server, and the source code of the viewer software. This allows developers to implement client software with limited functionality for special purposes.²

2.1 Terminology in Virtual Environments

Avatars are the actual representation of users in the virtual world and they can move around by walking or flying and even teleport to locally far distant locations, [6]. The appearance of avatars can be modified in terms of body shape and clothing [15]. Most users craft their avatar according to their real life appearance but tend to be more extroverted and thoughtful if compared to real life [11]. Personal items like virtual objects or clothing of avatars are referred to as inventory. Avatars can put items from the virtual world to the inventory or get inventory items from other avatars [15]. The world of Second Life provides users with a working economy and allows users to buy, sell, and even trade with objects. This implies that avatars have virtual money (bought for real money) that can be transferred to other avatars or exchanged for virtual items. A virtual world is also referred to as grid and comprises regions that are connected to each other [15]. Users can rent regions or at least parts of regions for shops or as a private accommodation for their avatars. Avatars can create virtual assets in these regions which are built by sticking together basic objects called prims, e.g. boxes, cylinders, or spheres. For a more realistic appearance users can change the color of these objects and even map textures onto their surface. Objects can not only have other objects and textures in their inventory but also embedded scripts that do simple but autonomous tasks, e.g. interact with other avatars. Scripts can trigger on events like touching the object, act as web servers that listens to requests, or even contact other web services. Further, every item records the creator and the current ownership of an object. If it changes hands the creator can further specify resell and modification permission of the subsequent owner of the item.

2.2 Virtual Selling Platforms
The business volume of user transactions in Second Life was about 160 Million U.S. Dollars in the first quarter of 2010 which is an increase of 30 % if compared to the previous year, [8]. One year ago in 2009, Guo and Barnes [4] released a study that focused on the buying characteristics of Chinese residents in virtual worlds which can be summarised as follows. Users do not spend money if they are not well entertained with the virtual world. In contrast to quest orientated virtual worlds e.g. World of Warcraft, vanity has a large influence on the buying behaviour of users in virtual environments with a high degree of freedom and user interaction. The benefit of virtual worlds if compared to existing e-commerce solutions is the similarity to real life. Potential customers can try on clothing from existing labels virtually and get attract to do the same in a real-world shop [5]. In contrast, a study from 2009 [11] showed that only 6% of users that bought virtual items did the same in the real world. An explanation could be the missing counterparts of virtual items in the real world and the young market of advertising in virtual environments. From a technological point of view, the ease-of-use plays an important role when buying virtual items. The mechanism to pursue the items should not be too complex because otherwise user are deterred from buying these objects. Finally, participants of this study believe in the security of in-world shops and the according in-world payment because all buyable items are already “in there”.

MacInnes [10] states that the first stage in the progress of evolution of a business model aims at technical issues. As

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1. http://www.opensimulator.org
2. https://wonderland.dev.java.net

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Figure 1: A typical scene from the virtual world of Second Life with an avatar in front and landscape that consists of different objects.
the early stage in the development of virtual environments implies a lack of the required criterions of stability and maturity the focus in the development of a platform to sell virtual items should be reliability.

2.3 Online Payment Systems

The minimum three parties for a virtual item’s sale are a merchant that sells virtual items, a user that buys virtual items, and a third party that is responsible for the money transfer [12].

Payments over the internet are an essential part of today’s economy. Besides cheque transactions and bank transfer the most prominent method to do online payments are credit cards. Although they compete with cash transactions they can be considered as insecure and untrustworthy for transactions over the internet [9]. Besides all security concerns the amount of money spent by the sender is not necessarily equal to the amount of money received by the merchant. Banks and credit card vendors deduct fixed or percent-wise commission for every single transaction [12].

A possible approach are micropayments that involve payments up to 5 Euros and try to keep the costs of each transaction low. Either several small payments are combined to one larger transaction or an external money deposit is charged for individual payments. Possible applications for micropayments are buying audio files, digital newspaper, or software over the internet, [13, 2]. As more and more users are willing to pay for digital content and services [19] the coverage of micropayment providers increases, e.g. PaySafeCard, Wallie, ClickAndBuy.

One important factor of the success of a webshop is the number of available payment methods. Abrazhevich [1] introduced the term “mediating system” that puts several payment solutions under one umbrella. He described the necessary steps of a successful checkout in a webshop with a mediating system as follows:

1. Select the favoured items from the webshop.
2. The checkout redirects the customer directly to the mediating service and prompts to select a specific payment provider.
3. The customer uses the selected payment provider to transfer the correct amount of money.
4. After money transfer the mediating service informs the merchant about the successful transaction.
5. The merchant can take further steps and consign the requested items.

In the upper scenario the merchant has a contract with the mediating service and does not care about the underlying payment providers. The most important benefit of this system is that both, the merchant and the buyer have a transparent interface for all payments.

The wide spread of mobile phones yields in micropayments supported by these mobile devices. In case of a payment the wireless network provider acts as third party because all payments made by the customer are settled by the monthly telephone bill. To do a payment, the customer calls a certain premium rated phone number and the wireless network provider transfers the according amount of money less fees to the payment provider. The payment provider again charges commission and sends the remainder to the actual merchant.

Pousttchi and Wiedemann [14] provided an example of a webshop with a mediating service that supports mobile micropayments. This process is similar to the example of a micropayment enabled checkout process.

1. The customer visits the webshop, select the favoured items and puts them into the virtual trolley.
2. After the checkout the mediating service offers a payment provider that allows a mobile payment.
3. The mediating service requests a certain phone number from the payment provider that can be correlated with customer and the actual payment, and sends it to the customer.
4. The customer verifies the correctness of the provided phone number, calls it, and makes the payment because the phone bill will be charged for this call.
5. The mediating service gets a notification of the call and informs the merchant about the made payment. Upon this notification the merchant can take further steps and consign the requested items.

Most mobile micropayment providers only offer fix-priced rates for a micropayment. Hence, merchants can not easily demand a certain amount of money for an item if the payment provider does not support this specific amount. To get rid of this problem users can top-up their webshop account with a mobile micropayment and charge it on a purchase. The mechanism slightly differs from the previously mentioned checkout process with a mobile micropayment.

1. In order to buy items, the user employs a mobile micropayment provider to top up the webshop account balance. Again, a payment provider offers a phone number that deposits the account of the user upon a made call.
2. Then the user can visit the webshop and put the requested into the virtual trolley.
3. After the checkout the webshop account is charged and the consignment of the items in the trolley starts immediately. If the balance is not sufficient the user is prompted to deposit the account again.

The benefit of this solution is a single payment that can be used for several independent purchases.
3. REQUIREMENTS

In Section 2.2 we have already mentioned two studies that focused on user’s buying behaviour in virtual environments. According to these studies we will define requirements for the external webshop that supports mobile micropayments.

3.1 Registration

It is not necessary to register with the webshop to browse through the offered items but in order to buy items a user must have an account with an assigned in-world avatar to ensure that bought items are delivered correctly. The registration process is similar to existing webshops and requires the user to provide personal information and login credentials, i.e. username and password. In addition, the user needs to provide the name of the in-world avatar that will be linked to the new account.

To link both accounts the backend of the webshop sends a message to the specified in-world avatar that contains a confirmation key and prompts the user to enter it in the registration form. The only way to access this key is to log into the virtual world and check the received messages. To complete the registration the user enters this code and hence confirms that the avatar exists and is under the user’s control. This mechanism also prevents from misuse because it preserves the unique mapping between users and avatar, i.e. it is not possible to create several webshop accounts for one single avatar because the webshop would detect existing accounts and denies the completion of the registration.

After the successful registration the avatar gets an in-world object that is used for further payments. To prevent from misuse it is bound to the avatar and can not be used by others.

3.2 Sell Objects

All items in the webshop origin from the virtual world and are uploaded by users. Due to copyright issues all items that are offered in the webshop remain inside the origin virtual world. The webshop only records meta-information that describes the object and a unique identifier that points to the actual item in-world.

The most important precondition to add items to the webshop is a valid and confirmed user account. Further, again because of copyright issues, we only allow creators of objects to upload them.

Merchants are not allowed to directly connect to the webshop and add items. Instead, an avatar with special functionality, referred to as webshop robot, is responsible for the entire interaction with the selling platform. As depicted in Figure 2, the merchant sends items to be listed in the webshop. The merchant is provided with a list of all uploaded items after logging into the webshop. Besides the activation flag, the interface allows to change the description of the objects, add pictures, and define keywords for indexing.

After a successful registration, an avatar gets a personalized paybox object with an embedded script for the communication with the webshop. The avatar attaches this object as Head-Up-Display (see [15] for further information) and the embedded script connects to the webshop. Thereafter, the avatar is provided with the dialog box depicted in Figure 3 to choose from the payment types “Send Linden Dollars Directly” and “Use a Mobile Micropayment Provider”. The first payment type transfers money from the user’s avatar account to the webshop account whereas the second payment type tops the webshop account by mobile micropayment. For the latter the procedure is similar to the already mentioned mobile payment scenarios. The dialog box provides the user with a phone number and the user calls this number. According to the rates the webshop account balance of the user is topped up.

3.3 Payment Types

Although we have mentioned that the introduced webshop supports mobile micropayments we offer a more generic payment solution to customers. Section 2.1 states that avatars have virtual money for their disposal which can be obtained from different exchange providers like VirWoX8 or DX Exchange9. Further it mentions the drawback of fixed rates of mobile micropayment providers and the resulting need for a money account at the webshop.

After a successful registration, an avatar gets a personalized paybox object with an embedded script connecting to the webshop. Besides the activation flag, the interface allows to change the description of the objects, add pictures, and define keywords for indexing.

3.4 Buy Objects

After the successful registration with the webshop a user can log in, browse through the offered items, and buy them. The user can search for specific objects, compare them with others, and put finally the desired items into the virtual trolley. After the checkout the webshop decides upon the account balance of the avatar how to proceed. If the balance

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8http://www.virwox.com
9http://www.dxexchange
Figure 3: The user can choose whether to transfer money from the avatar's account to the webshop account or charge it by a mobile micropayment.

is sufficient the account will be charged with the purchasing price, otherwise the user is prompted to charge the account with the in-world paybox.

The consignment process is depicted to Figure 4. The webshop sends a request to the prim vault that contains information about the objects to deliver and the recipient. The responsible script embedded in the object checks the inventory, localises the avatar and delivers them.

Figure 4: In case of a payment the webshop directly connects the object vault to deliver a certain items.

4. ARCHITECTURE OF THE SYSTEM
In this section we will describe used technologies and the architecture of the system but focus on the design instead of any implementation issues.

4.1 Design of the Selling Platform
We did not implement an entire webshop from scratch but used the existing Magento eCommerce platform\textsuperscript{10}. It is a modular designed open source software with a clear separation of code and design. Further, it provides application programming interface (API) to create products, get user information, or trigger any webshop events with XML-RPC web requests.

Existing mechanisms to register at a certain webshop use web links that are sent by mail to confirm an account. As we send a confirmation code to the in-world avatar the registration module has been modified slightly. In Section 3 we have stated that the webshop sends a key to the in-world avatar to confirm the registration. Unfortunately, Linden Labs prevents this and does not allow to send messages to an unknown avatar just upon it’s name. To get rid of this problem we initialize the registration process in-world with so called “registration terminals”. To do so, the avatar touches the terminal and is provided with an URL that contains the name of the avatar and a unique in-world identifier UUID as GET parameters. The user clicks the URL and is redirected to the registration form of the webshop. As the avatar can be clearly identified by the GET parameters, the user is only prompted to provide login credentials, i.e. username and password. To send the key for the account confirmation to the avatar we employ the registration terminal. It acts as web server that triggers on requests from the webshop. These messages contain a confirmation key for the registration process and the UUID to identify the corresponding avatar. Upon this requests the terminal sends an instant message to the specified avatar to provide the specified avatar with the confirmation key. The user enters the received key into the webshop form and completes the registration process.

The webshop framework suffers from missing multi-seller functionality. The additional features needed for more than one seller can not be implemented as single module because it requires some major changes of the webshop’s core functionality. Intentionally, the webshop allows users to browse through the webshop which is a simple read operation from the perspective of the underlying database. An important criterion for a webshop with more than one seller is the ability to add, modify, and even delete items from the webshop, i.e. from the perspective of the database this are create and remove operations. The Magento webshop framework distinguishes between users and administrators and users are in general not allowed to delete or modify items in the underlying database. The only way to provide this functionality to users is to open this permission system in terms of the database access. If a user logs into the webshop all personal items are identified according to their “ownership” in the database. Due to the extended permission system a logged in user is provided with the list of personal items and even allowed to modify them.

The only accepted payment method the webshop offers is by charging the pre-paid money balance of a users avatar. To provide this functionality we have created a separate module that stores the balance information of the users and provides an interface to charge and deposit the according account. In case of a purchase the webshop directly accesses the mod-

\textsuperscript{10}http://www.magentocommerce.com
ule to charge the account balance of the user. In case of a payment to top up the account balance an external service, e.g. payment provider or mediating system, needs to access the module. To be consistent with the other webshop’s API functions, this call is an XML-RPC request that contains an identifier for the webshop user and the amount of money for the deposit.

As described in Section 3.2 the user can only add items to the webshop by sending them to the in-world webshop robot. This robot employs a slightly modified version of the existing webshop API to create new objects. The additional information consists of a reference to the actual avatar that owns the object an identifier to access the in-world object correctly. This changes also require modifications of the webshop’ underlaying database to store these additional information. All other parameters like name, description, or price of the object are already covered by the origin API request.

To prevent from attacks the request to create a new webshop item should be only accessible by the in-world robot that receives the virtual items from the seller’s avatars.

### 4.2 Webshop Robot and Object Vault

To create the webshop robot we employ the open source non-graphical client library libopenmetaverse. It implements the basic functionality to interact with the virtual world and can be easily extended.

If a user decides to add items to the webshop it simply sends these items to the webshop robot. The webshop robot detects incoming items and extracts all information from this object. For identification purposes the robot renames the object to and sends this information with the extracted meta information to the webshop. According to Figure 2, the robot does not store the received item in it’s inventory but sends it to a “prim vault”. In the virtual world of Second Life avatars can join groups that can for example share the same permissions to access objects, e.g. if an object is group owned all members can access, modify, and even delete these objects. Due to reliability reasons of the service we do not employ one single robot but a group of robots instead. As all webshop robots can access the “prim vault” a robot that is out of order does not influence or even break down the entire service. This implies a slightly modified version of the registration described in Section 4.1 because webshop sends a request to all webshop robots to send a friend request to the user’s avatar. For the actual upload process the merchant can choose from a list of robots in it’s friend list to send the items to because all robots can access the vault and connect to the webshop.

The mechanism to buy objects from the webshop described in Section 3.4 does not need any modifications because all required functionality is already implemented in the webshop framework. Users can search for items, compare them, and finally put them into a virtual trolley. After the checkout the account balance of the user is charged and the webshop delivers the purchased items by sending a request to the in-world object vault. As depicted in Figure 4 this request contains information about the recipient a and the actual item id, to be delivered. The object vault detects these requests and finds the according object in it’s inventory. Then it locates the specified avatar, and consigns the item. If the avatar is not online it gets a notification, respectively the actual object, upon the next login.

### 4.3 Charge Webshop Account

The only way to charge the webshop account is to use the paybox object received up the registration. If this object is attached as head up display and provides the user with the dialog window as depicted in Figure 3.

If the users decides to directly transfer money from the in-world account to the webshop account the paybox sends money from the owner’s in-world account to the in-world account of an avatar that is related to the webshop, referred to as payment robot. First, the paybox provides the user with an interface to choose the amount to be transferred to the webshop account, e.g. 100, 200, or even 1000 L$. After confirming this payment the paybox sends the money to the payment robot. The payment robot is similar to the webshop robot but triggers on incoming money. The robot extracts the sender and the actual amount of money from this event and sends a request to the web service API described in Section 4.1 to deposit the senders webshop account balance. The entire mechanism with all involved parties is depicted in Figure 5.

The second payment method does not require to have in-world money but employs a mobile micropayment payment provider. For demonstration purposes we have only implemented one payment provider called Allopass\(^\text{11}\) with a mechanism that slightly differs from the mentioned payment methods in Section 2.3 because it does not offer automatic notifications upon a made payment. Instead the webshop customer calls the provided premium charged phone number and is provided with a validation code as a proof of payment.

We have implemented an external “payment service” that connects the in-world paybox object with the payment provider and the webshop. If the user requests to charge the webshop

\(^{11}\text{http://www.allopass.com}\)
account by micropayment the paybox object contacts the payment service that replies with information about possible payments and the according phone numbers. The user chooses one of this phone numbers to be called and a telephone answering machine provides a verification code. To prove the made phone call the paybox prompts the user to enter the received code in a dialog depicted in Figure 6 and sends it to the payment service. This code is used to employ the Allopass web API to check the validity of the provided data. The payment service decides upon the answer whether to contact the webshop to deposit the user’s account or send an error to the paybox that requests the user to enter a valid code.

Currency? L$ or EUR?

Figure 6: The user is provided with a keypad to enter the received payment-verification-code.

Figure 7: An avatar interacts with a with an payment provider by using a personal paybox and a payment service to charge the webshop account.

4.4 Design Limitations

Although, the Magento Webshop framework lacks of the required feature of a multi-seller functionality we have decided to customize it to provide the required functionality. It was not possible to add this functionality by adding a module but we needed to modify the core parts of the webshop. This customisation rises two major drawbacks. First, the made modifications aim at the database layer to allow users to edit their own objects and even delete these object. Despite a careful and well considered approach to do these modifications it is possible to open security holes to compromise the entire system. Second, the update of the entire Magento platform seems more complicated because of the modification of core functions and methods. The update process needs careful investigation and testing to ensure the correctness of the entire functionality.

Another critical part of the implementation is the communication between in-world objects or avatars, and the out-world webshop or external services. By now, the implementation bases on shared keys used for authentication. This approach is suitable for a prototype that shows the functionality but it is definitively not suitable for a productive system due to the additional overhead of storing these keys.

5. RESULTS AND CONCLUSION

In this paper we have presented an a webshop service that provides a single platform for virtual items. Although it is limited to the virtual world of Second Life, the presented approach can be easily modified to be used with other virtual worlds. The introduced platform does not provide any explicite payment methods but uses a money account that is directly bound to the customer of the webshop. To top up this account the in-world avatar linkt to the webshop account is provided with a paybox that offers two different payment methods. Either the used can transfer money from the avatar account to the webshop account or use a mobile micropayment instead. Due to consistency reasons we do not offer any other payment for the checkout. Users are only allowed to top up their webshop account by using the simple interaction with the paybox object. For demonstration purposes we have only implemented the service of the mobile micropayment provider Allopass but due to the generic design of the payment service, other providers can be added easily.

6. REFERENCES

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