cryptocARrency : Ambient User Interface with Mobile Web AR

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ABSTRACT

This paper describes an information visualization system comprised of an ambient user interface (AUI) and augmented reality (AR) graphics viewed in a mobile web browser. Current and historical values for Bitcoin are collected and analyzed for changes in value over time. The amount and direction of change in these values over the past day is communicated through an embedded computing object's light levels and color values. Related AR graphics indicate changes for the past seven days.

CCS CONCEPTS

• **Human-centered computing~Information visualization** • Human-centered computing~Mixed / augmented reality • Human-centered computing~Ubiquitous and mobile computing systems and tools • Human-centered computing~Web-based interaction

KEYWORDS

Mobile augmented reality, web development, industrial design, interaction design, digital currency, cryptocurrency, embedded computing, ambient user interface, information decoration, information design.

1 INTRODUCTION

In this project, the change in value, for each day of one week, for Bitcoin (BTC), is represented in an embedded computing object and AR graphics viewed in mobile web browsers. The object communicates the change in BTC value from yesterday to the current value. The AR graphics add information for seven additional value changes, each graphic represents the change in value for one day. The object is a pyramid form with a microprocessor and LEDs (Light Emitting Diodes). The pyramid contains white, green, and red LEDs. The microprocessor is programmed to periodically collect and compare the current value of Bitcoin and the value of the closing value from the previous day using a web API (application programming interface). The amount of change in the two values is translated into brightness values for the white LEDs in the object. The greater the change, the brighter the white light. The direction of the change is communicated by turning green (positive) and red (negative) lights on and off. By communicating information through the transmission of light color and value, the pyramid is an AUI. [Krumm, John (Ed.). 2010]. Because this object can be placed in an environment where the user monitors it in a peripheral manner, it is also an implementation of information decoration. [Krumm, John (Ed.). 2010]. When the pyramid signals information that is of interest, it can be placed in proximity to an AR marker. Viewing the object and marker with a smartphone or tablet camera, content is represented in in a mobile web browser web page authored in HTML and CSS, with AR.js, THREE.js, and A-Frame JavaScript libraries. In the web page, data queries are made with the same Bitcoin data API as used in the pyramid's microprocessor. A 3D graphic for an icosahedron is rendered for the BTC value change for each day of the previous seven days, in proximity to an AR marker. Distance from the object represents time; the nearest graphic to the object signifies the most recent daily BTC value change. The color of each 3D graphic, green or red, indicates a positive or negative value change. The size of the graphic form represents the amount of change in that time period. The greater the value change, the larger the icosahedron radius.

2 PROJECT GOALS

This project is an exploration of information design for an AUI that can be used as a stand-alone object, and in combination with mobile AR content. The AUI communicates information at the micro level, displaying the change in one day of data. When the object is placed in proximity to the AR marker and viewed in a mobile web browser, it is part of an information design that displays the data changes for several days, creating a micro and macro level information design. [Tufte, Edward R. 1990]. The pyramid object (3 x 3 x 6.5 inches) is designed for use in a social space (4 to 12 feet). When it is combined with the mobile AR space, it is experienced in a personal space (18 inches to four feet). [Hall, E.T. 1966] Information is not specific, but communicates the data value changes in a relative manner.

3 RELATED WORK

There have been experiments in the design of material representation for Bitcoin. Block Bills, [Petulla, Sam 2017] is an artistic visualization of BTC paper currency based on traditional representations for currency. Datafountain, is an implementation of computational information decoration. Relative currency rates are displayed using water fountain levels. [Datafountain 2017]

4 DESIGN / TECHNICAL INFORMATION

4.1 AUI / Embedded Computing Object Design

This object is an implementation of ubiquitous computing with industrial design and the use of light to transmit information; an AUI. The object is to be placed in an environment where it can be monitored peripherally. Using the ESP8266 microprocessor, with Arduino software, current and historical BTC value data is gathered from the coindesk.com API by WiFi. Data is evaluated and used to control the LEDs. The design of the object, using a pyramid form, semi-transparent acrylic, and shoji (fiberglass) paper is influenced by the work of Thomas Wilfred (1889 – 1968), who used light in 'lumia' performances and stand-alone artworks. [Betancourt, Michael 2006]

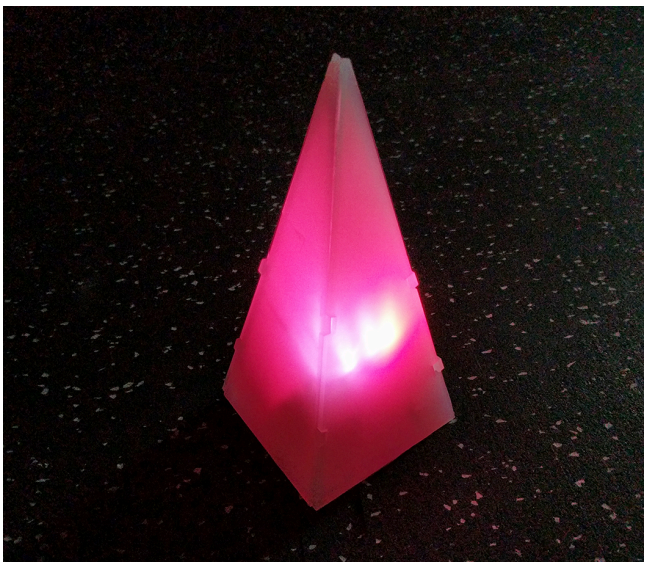

Figure 1: AUI indicating negative BTC value change, one day.

4.2 Mobile Augmented Reality Design

Mobile web AR content is developed with HTML, CSS, and AR.js, THEE.js, and A-Frame JavaScript libraries. AR.js is an open source JavaScript library developed by Jerome Etienne. Built with ARToolKit.js, a JavaScript port of the ARToolKit SDK (software development kit), AR.js allows for the development of HTML web pages to include AR (augmented reality) content (Etienne, Jerome 2017). AR.js requires WebGL, a 3D graphics API for the HTML5 Canvas element, and WebRTC, a set of browser APIs and protocols that allow for real-time communications of audio, video, and data in web browsers and native apps. WebRTC requires encryption, and a web server configured for https (secure hypertext transfer protocol). WebGL and WebRTC are supported in current Android mobile devices and Apple iPhones with iOS 11. AR.js can be used in conjunction with THREE.js, a JavaScript library for the development of 3D web content; and, as demonstrated in this project, AR.js can be used with the A-Frame framework (Etienne, Jerome., 2017), a JavaScript library for creating web VR (virtual reality) content.

Performance on mobile devices is best in Google Chrome for Android, and Safari for iOS, but other browsers can also be used, such as Firefox.

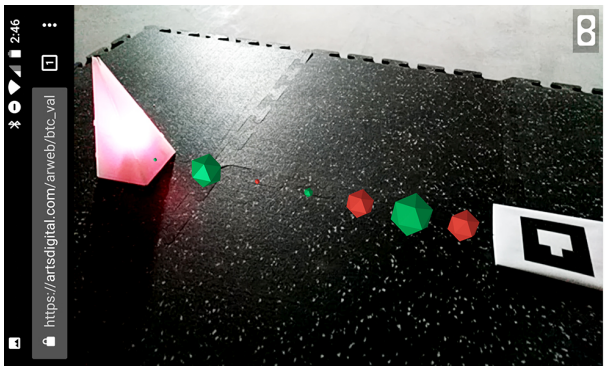

Figure 2: AUI with AR marker and graphics in mobile browser.

5 CONCLUSIONS AND FUTURE WORK

In this project, an information visualization system is developed. A design prototype is implemented incorporating an AUI and associated mobile AR graphics, developed with open source web tools. Data for Bitcoin value changes are sample content. Other data can be visualized using this system. The AUI object can have additional functions as an interface, accepting this data and representing information with additional displays of light. When the object is viewed with the AR content, design choices can be changed to determine the computation of the AR graphics. Currently there is one embedded computing object and one design of related AR content. In future work, the system can be designed for separate data sets to be associated with multiple objects. Each object can have unique AR content. Each object and related AR content can represent one cryptocurrency. Comparisons can then be made between several different cryptocurrency values. Within the system, multiple AR markers can be used in conjunction with the AUI object. Each side of an object can have an individual AR marker and unique graphics connected to that marker, representing separate sets of data. Evaluations of different sets of data for one cryptocurrency can be made. The components can be configured to create many variations in information design.

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