



"Gift Box: Including Social Objects in the Internet of Things"

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Gift Box: Including Social Objects in Internet of Things

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Abstract

This paper highlights a research gap in the Internet of Things, i.e., the absence of social objects that matter to non-technical everyday users. Social objects are existing physical objects that people bond with, are attached to, or that connect people to each other. We conduct a study, named Gift Box, to specifically look at the social aspects emerging within the Internet of Things (IoT). The study represents gifts, a specific category of social objects that connect people to each other, through pictures on a social media website. The study offers a first step for users to include objects that matter to them in the IoT.

This paper focuses on the person-to-person connections supported within the IoT. We address a relatively unexplored question, “In what ways does the Internet of Things affect interpersonal connections?” We provide an overview of the Internet of Things, as it currently exists, covering both academic and commercial work. This paper discusses 1) a Technology spectrum for the Internet of Things to support consideration about the kind of objects, technology within the objects, and capability of user contribution to creation of the Internet of Things and 2) Gift Box user study including objects that matter to users and exploring the social aspects to engage users in the Internet of Things. Understanding user engagement and sociality supported within the IoT can lead to a more successfully accepted Internet of Things.

1. Introduction

An augmented coffee pot [1] was one of the first objects to be put on the network. It can be seen as an early instance of the Internet of Things. The pot sent out pictures indicating the state of the coffee machine i.e. whether it was full or not, or brewing coffee. Imagine the same coffee pot, designed for a different purpose in mind—an augmented coffee pot to support social interactions, by communicating and spreading awareness about others’ activities and schedules [2]. One could know if someone else was making coffee in the common room, and could decide to walk up there, to hang out, chat or discuss something important. The Internet of Things has a social aspect to it, which is often neglected. Augmenting everyday objects affects people’s behavior, and has social consequences. This paper addresses issues about the Internet of Things with a vision to support communication, awareness, interactions, and connections between people.

The Internet of Things is an interconnected network of smart objects and devices. Objects in the world of the Internet of Things, mostly referred to as smart objects, are augmented to have RFIDs, NFCs, codes, microprocessors or sensors built in or attached to them. Networked objects create a continuous data stream, which can be connected to offer services to users.

This paper addresses some questions around the social perspective of the Internet of Things. Does the Internet of Things help us bond with our family, friends or loved ones? Can the IoT serve to strengthen social ties? In what ways does the Internet of Things affect interpersonal relationships? What are the new ways of information, exchange, and communication that the IoT enables among people? What are the social interactions and practices that emerge out of, within, and due to, an interconnected network of things? What new connections evolve between people by having augmented objects all around them? Our hypothesis is that social objects that matter to people are not well represented in the IoT.

I conducted a user study, named Gift Box, to explore sharing and connectedness through the Internet of Things. Through the study, I identified social objects that matter to people, and discussed their representation in the IoT. In order to focus on the social aspects, I intentionally chose objects that have sentimental value in the real world. I restricted my focus to gifts in the form of tangible objects. The study asked participants to identify five gifts that are special to them, and to put pictures of the gifts up on Facebook. The study identified social objects that matter to people, and explores the interactions enabled by representing them online. The study looked at ways to express online, our connections to cherished things.

Many research projects take the approach of communicating intimacy through an augmented physical object. An example is the Physical Intimate Object, which has an LED on a metal box that glows when one person in the relationship clicks it [3], [4]. Other examples are inTouch [5], Feather, Scent and Shaker [6] and CoupleVIBE [7]. Studies have been done with family members, grandparents, friends and couples to see how augmented objects specifically designed for intimacy bring people together. I propose studying the reverse concept, i.e I used the sentimental objects that already exist in the real world, and represent them online. In our project, I do not take the approach of designing an object. Instead, I picked objects that already exist in the physical world, and represent them online.

2. Motivation

In 2008, the number of things connected to the Internet exceeded the number of people on earth¹ [8]. The Internet of Things affects everyday lives of people all around us. Users get information from objects, and have novel ways of interacting with them. One can swipe (or wave) a smart card to process payment while taking a bus, train or subway. One crosses a bridge, and the tollbooth automatically deducts money from the owner's card. One can look at an object (Google Goggles, computer vision, through a mobile phone, augmented reality), and one can find out all that he wants to know about the object (and more!!) RFIDs are used in stores for supply chain management. Parking meters update their status, so that drivers can know the vacancy in a parking lot. Smart meters in homes give updated information about electricity consumption; smart devices communicate with the appliance to find out its electricity consumption. Accelerometers attached to shoes keep track of the pace and distance covered while running. Wearable computing is an extension to this idea, which relates to human actions in more direct ways. Bio sensors and wearable medical gadgets keep a record of the health conditions and parameters in a body. The Internet of Things offers 1) new kinds of information provided by augmented objects, 2) ways of interaction, with and through the objects and 3) services provided due to the interconnection of objects.

The Internet of Things changes the way in which we interact with objects. This change also affects the ways in which people interact and communicate with each other. Many studies have looked at the interconnection between people through devices like computers, laptops, mobile phones and tablets [9]. However, little work has been done to explore interconnection between people through smart objects. As people begin to use the objects in the Internet of Things, they begin to communicate and socialize in new ways. Hence, to understand how users engage with the IoT, it becomes important to understand the social practices emerging within the IoT. This paper studies the social practices and interactions emerging as a result of the Internet of Things. More specifically, the study looks at the digital representation, in the form of pictures, of gifts on a social medium (Facebook).

Before describing the Gift Box study and its findings in detail, I discuss the need and intentions for conducting the study. The following sections of the paper provide an overview of the Internet of Things, covering both academic research and commercial products. Next, I propose an analytical framework to place the objects in the IoT on a Technology spectrum. A Technology spectrum for the Internet of Things is a way to categorize the objects based on the kind and degree of technology present in the augmented object. I identify research gaps in the domain, and explain how the user study was designed to uncover the social aspects within the IoT. The second major half of the paper covers the findings and discussions of the Gift Box user study, suggesting ways to fill in the research gaps by engaging users and including social objects.

3. The Internet of Things: An Overview

3.A. Related Work (IoT in Academia)

This section covers the research work and projects in academia related to the Internet of Things. We begin with some definitions and explanations associated with the term Internet of Things. The basic idea of this concept is the pervasive presence around us of a variety of *things* or *objects* – augmented with Radio-Frequency Identification (RFID) tags, sensors, actuators, mobile phones, etc. – which, through unique

¹ CISCO Infographic: <http://blogs.cisco.com/news/the-internet-of-things-infographic/>

addressing schemes, are able to interact with each other and cooperate with their neighbors to reach common goals [10]. The “Internet of Things” semantically means “a world-wide network of interconnected objects uniquely addressable, based on standard communication protocols [11]. This implies a huge number of (heterogeneous) objects involved in the process. The vision is a new era of data production where humans may become the minority as generators and receivers of traffic and will be dwarfed by those prompted by the networking of everyday objects [12], [13]. A similar vision is shared by the European Commission, in which the most recurrent definition of the IoT involves “Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts” [11].

3.A.i. Different Visions

The IoT is a convergence of various visions, evolving together based on the stakeholders’ focus of development. Atzori [14] identifies three classes of visions within the research community of the IoT: Things oriented, Internet oriented and Semantic oriented.

Things oriented vision. This perspective focuses on the ‘Things’ in the Internet of Things. The primary concern is the objects that will be connected in such a network, and the technologies used to augment the objects. This perspective originated from Auto-ID and EPC Global, leading research laboratories in the field of networked RFIDs. Welbourne et.al. [15] discuss RFIDs to be the major components in the IoT. According to the RFID centric vision [16], [17], [18] RFID stands at the forefront of the technologies driving the IoT. However other visions extend the idea broader than just RFIDs, thereby including embedded systems, processors like Arduino and wireless transmitters and receivers. Things oriented perspective envisions Near Field Communications (NFC), Wireless Sensor and Actuator Networks (WSAN), 2D and barcodes together with RFID, as “the atomic components that will link the real world with the digital world”.

The main issues of this perspective are object identification and addressability. The idea includes a UID (Unique/ Universal/ Ubiquitous) code, to identify the object uniquely. Such an approach aims for a global visibility of the object. Interoperability of interconnected devices is seen as a challenge in the field. The interconnected things that form the IoT will have limited energy, processing and transmission capabilities. Resource efficiency needs would be given special attention.

Internet oriented vision. This vision is concerned with the protocols for communication networks. The Internet oriented vision discusses the IPSO (IP stack for Smart Objects) [19]. The IPSO alliance envisions a modified version of the current Internet Protocol (IP) to enable the IoT. The domain of smart objects requires scalable and interoperable communication mechanisms that support future innovation and growth. The existing IP technology is a long-lived, stable, and highly scalable communication technology that supports both a wide range of applications, devices, and underlying communication technologies. The IP stack is lightweight and can run on tiny, battery operated embedded devices. IPv6, with its capability to support 340 undecillion (10^{36}) Internet addresses, has the qualities to make the Internet of Things a reality, connecting billions of communicating devices [20]. The approach uses the IP stack to enable “IP over anything.” Another protocol that is discussed in this area is the 6LoWPAN [21]. 6LowPAN stands for IPv6 over Low power Wireless Personal Area Networks. The idea includes using low power devices, with limited resources and processing, in the Internet of Things.

The protocols for networking play an important role in the Internet oriented vision. “According to both the IPSO and Internet based approaches, the IoT will be deployed by means of a sort of *simplification* of the current IP to adapt it to any object and make those objects addressable and reachable from any location.” [22]. The Web of Things [23-26] community reuses the existing Web standards (URI, HTTP, REST etc.) to fully integrate the interconnected things to the “web”. The smart objects are put over and accessed through the Web.

Semantic oriented vision. The third vision within the IoT is semantic oriented. The number of devices and objects in the Internet of Things is extremely high, with the number being predicted as 50 billion in 2020 [8]. The semantic oriented vision focuses on the organization, storage, retrieval, representation,

interconnection, and search of the immense data coming in from interconnected objects [27]. The objects are not necessarily addressed not by their unique identifiers, but by associating meaning (semantics) to their addressing and identification mechanisms. This vision includes ontologies from the Semantic Web, and related languages like RDF and OWL. A joint roadmap for Semantic technologies and the Internet of Things [27] covers architectures, models and execution environments for using semantics in the IoT.

3.A.ii. Privacy

Many researchers Weber et. al. [28], [29], [30], [31] address issues of privacy and security related to the IoT. Rob van Kanenburg, in his book The Internet of Things, critiques ambient technology and the all-seeing network of RFIDs [32]. The legal policies regarding RFIDs need to be framed to ensure consumer privacy [28]. Weber argues for an international legal framework to support privacy in the IoT. He points out that so far, the regulatory model in the IoT is based on self-regulation through manifold business standards, starting from technical guidelines and leading to fair information practices. The paper questions whether the existing regulations are sufficient to ensure security and privacy in the IoT. It focuses on objects having RFID tags, discusses issues related to monitoring products, animals and people.

Europe is looking at legal frameworks to address security and privacy in the IoT. In April, 2011, the executive body of European Union signed the Privacy and Data Protection Impact Assessment (PIA) Framework for RFID Applications [33]. The PIA framework is a legal procedure to ensure consumer privacy in RFID applications and connected devices.

The PIA framework is a way to identify the privacy threats possible; to support their mitigation and documentation. The PIA framework involves four steps:

- 1) Describing the RFID application
- 2) Identifying the possible privacy risks and threats. Estimate magnitude and possibility of occurrence of the threats.
- 3) Documenting ways to control the identified risks
- 4) Documenting results of the analysis in a PIA report

The paper also discusses procedures to ensure the PIA framework is followed. For each RFID application, one needs to identify whether the application requires a full scale or small scale PIA. This depends on the kind of information processed: applications that process or store personal data (or personally identifiable data) require full scale PIA. Small scale PIA is for lower risk applications, and has relatively lenient controls and documentation.

3.B. Everyday Objects

Another body of literature that informs our research is around the importance, bonding, consumption and display of everyday objects. Anthropologists, thinkers and writers talk about the Things that matter in people's lives; how and why they become special. Sherry Turkle, in her book Evocative Objects: Things we think with, discusses our attachments to everyday things. Objects are seen as emotional and intellectual companions that anchor memory, sustain relationships and provoke new ideas [34]. In the paper On Human Remains: Values and Practice in the Home Archiving of Cherished Objects, Kirk and Sellen study cherished objects in homes. They discuss how and why objects become special, and how practices surrounding their archival and display can inform future domestic archiving technologies [35].

Adam Greenfield talks about information shadows of networked objects. The data from objects is imported into the datasphere, by linking the real world to their online presence through technologies like RFIDs or barcodes. In his book, Everyware [36], he writes, "The significance of technologies like RFID and 2D barcoding is that they offer a low-impact way to import physical objects into the datasphere, to endow them with an informational shadow." Julian Bleecker, interaction designer and researcher at Nokia Design, coined the term blogjects [37] for objects that blog. In the paper A Manifesto for Networked Objects — Cohabiting with Pigeons, Aphids and Aibos in the Internet of Things [37], he states, "Things in the pervasive Internet, will become first-class citizens with which we will interact and communicate." Daniel Miller, in his books Stuff [38] and The Comfort of Things [39], discusses our relationships with things, and

the material and consumption cultures around them.

The idea of spimes [40] by Bruce Sterling is also relevant. A spime is “a location-aware, environment-aware, self-logging, self-documenting, uniquely identified object that flings off data about itself and its environment in great quantities”. It is an object that can be tracked through space and time throughout its lifetime and that will be sustainable, enhanceable, and uniquely identifiable. The idea of spimes can be implemented through objects in the Internet of Things.

3.C. Commercial Products (in Internet of Things)

This section covers many consumer products that fall into the realm of Internet of Things. The products or the companies do not necessarily associate with the label of “IoT”, or market them as such. However, the objects that it includes belong very much to the area of the IoT. It is important to include such commercial ventures in this overview, as the IoT as an area, in addition to academic researchers, is also being developed by companies, industry ventures, hacker community, technologists, entrepreneurs and DIY enthusiasts.

The approach at Sony Ericsson regarding the Social Web of Things² renders a Facebook like interface for users to understand and associate with the Internet of Things. The model is layered on top with a layer of services, which are offered over these interconnected objects. For example, car insurance, courier, service or repair services can be linked to the objects. The car, once on the network, has all information about its purchase, owner, service and repair history linked to it. It can identify when the next service is due, and automatically coordinate with insurance and servicing agencies. If synced with the owner’s calendar, it can setup an appointment for servicing based on his/her schedule.

Many consumer products that belong to the IoT are sold in the domain of healthcare. The Nike+iPod Sensor³ embeds an accelerometer into a pair of sneakers, which can track the pace and distance of a walk or run. It can calculate the calories burnt, and this data can be used for logging and analysis over time to achieve healthy behavior by promoting exercise. The data can be shared with peers to promote competitive motivation. Another advantage of such automation is that the user does not need to log the data manually. Activities can be detected based on usage of certain augmented objects. Users are sent schedules and reminders, depending on whether the item is being used as expected or not. GlowCaps⁴, an augmented screw-on cap for medicine bottle, sends reminders when one forgets to take pills according to the prescription.

The IoT is useful in the utility sector. Individual appliances or fixtures connected to the grid can be beneficial to influence usage of water, gas, electricity or other resources. Appliances can be controlled remotely through the web via a smart device. Smart meters log electricity consumption at the home or appliance level. Statistics over time about such usage can be analyzed, and displayed to users to motivate them to take pro-environment decisions. Tools are designed to promote green transportation choices (UbiGreen) [41], healthy exercising behavior (UbiFit) [42] and water sensing in homes to give feedback about water usage [43-45]. The Design of Eco Feedback Technology [46] covers tools and ambient displays that combine sensing and feedback to users. The data can also be shared with other users, or put on a connected social media, to create competition, set goals, achieve motivation and influence public approval.

The Hammersmith Group has published two reports on the Internet of Things - The Internet of things: Networked objects and smart devices⁵, and Clicks & Mortar: Web 4.0, The Internet of Things⁶. They have many examples of consumer products in the realm of the IoT. The IoT is also making progress by contributions from the DIY community. Hackers have connected their coffee machines, toasters and

² http://www.ericsson.com/thinkingahead/idea/110217_social_network_for_you_1968920151_c

³ <http://www.apple.com/ipod/nike/>

⁴ <http://www.vitality.net/glowcaps.html>

⁵ http://thehammersmithgroup.com/images/reports/networked_objects.pdf

⁶ <http://thehammersmithgroup.com/images/reports/web4.pdf>

everyday objects to the Internet, or augmented them to update and post status on Twitter. An example is a washing machine that tweets when the load is done. Technology hobbyists use the Arduino microprocessor to make interactive objects. Companies like Green Goose and ThingM sell sensors, stickers, smart LEDs and starter electronic kits to DIY enthusiasts.

Startups are jumping into the bandwagon of the Internet of Things. Pachube is a platform for the Internet of Things, developed to store, share, and discover real time sensor, energy or environment data streams. Data is created through thousands of data points in environments, buildings, machines, devices, appliances and sensors. Interactive gadgets for entertainment and leisure focus on catching the attention of everyday (non-geek) users. WineM⁷ is an interactive rack of wine bottles; that glows up dynamically to select and recommend users' choice of wines. ThingLink⁸ supports user interactions with the Internet of Things, using images on the web. Users can tag objects in the images, with details, information or comments.

One of the aims of the inter-networking of things is to make lives faster and more efficient. This is done through automation, remote access and better control and management of devices. The calendar, alarm clock and coffee machine transmitting information to each other, can help in organizing and maintaining everyday routines, and smoothly handle deviations from the norms. The kitchen equipment can turn on when it knows one has left office and is in her car [47]. The IoT is also useful for shared devices and appliances. For example, community members can find out whether the shared washing machine is busy or in use. Users can remotely reserve time slots to schedule use of shared appliances. Frequently shared items like books in the library and rental cars have dedicated infrastructures for reservation and sharing. With all objects being a part of the Internet of Things, such systems can easily be implemented for everyday objects.

4. Analytical Framework: Technology Spectrum

In order to understand the IoT, I have designed an analytical framework - the Technology spectrum for the Internet of Things. The Technology spectrum (Figure 1) chalks out the various kinds of objects within the IoT, depending on how advanced the technology within the augmented object is. The overview highlights that there are many academic and industry products that fit in the field of the IoT. These products vary greatly in the kind of technology embedded within the object. The Technology spectrum visually classifies the objects in the Internet of Things in three segments: Digital Representations, Hybrid Entities and Smart Objects.

The spectrum, on one end, involves purely Digital Representations of objects online. The interactions with the object happen on a digital or social medium, with little (or no) effect on the physical object itself. No technology is embedded within the object. Hybrid Entities form the middle segment. Codes (or some marker on the object) provide a strong link between the physical object and its digital representation. Interactions occurring with the object can be physically reflected through LEDs or sound actuators. The other extreme end has Smart Objects. Smart Objects are augmented with technology, in the form of RFIDs, sensors, NFCs, microcontrollers and so on. We explain the placement of various objects on the spectrum, beginning from purely digital representations and ending with the most technologically advanced smart objects.

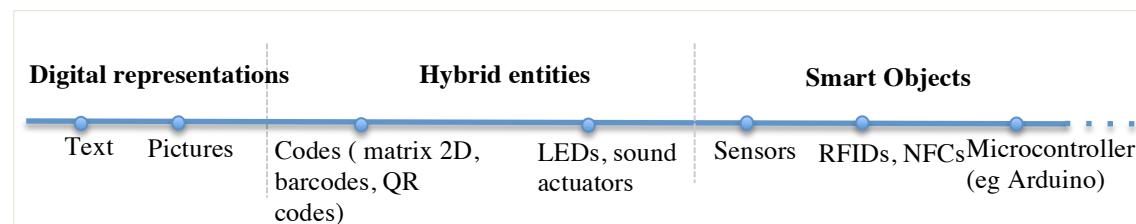


Fig 1. Technology spectrum (for Internet of Things)

⁷ <http://thingm.com/products/winem.html>

⁸ <http://www.thinglink.com/>

Digital Representations. This may involve representing the existing physical object, in the online world, by having a virtual representation of it. The functionality and interactions with the object happen only through the digital medium. Users can create and put up a virtual replica of any object they like, without having to deal with any technology aspects. Currently users create objects in games and virtual worlds like Second Life, which also belong on the Digital Representation end of the spectrum.

Text and Pictures: Text and pictures can be considered as the most basic form of representation. With textual representation, objects can be addressed and identified through a search bar. For pictures in the IoT, users can manually put up pictures of objects of their choice.

Hybrid Entities. As more and more objects have an online presence, we might need to establish, identify and display that an object is a part of the IoT. This may be done through some kind of markers, stickers, tags or labels, which establish that the object has been included as a part of the IoT. The process may also be needed for establishing ownership and authority, and distinguishing and identifying the objects already “up there”. This process moves an object from being purely representational to becoming a hybrid.

As we move from the least demanding technology-wise to the most technology-oriented approach, we have objects having codes (barcodes, 2D codes, QR codes etc.) as a medium to identify and transmit small amount of information from the object. Codes can act as links to direct the user from the physical tangible object, to its representation online, or in a database, or its representation on a digital medium as well.

Some objects may be embedded with LEDs or actuators. These could produce sound or lights, to physically represent changes in the digital representation. The output forms provide a way to link the physical to the digital world. These are augmented objects that can display some form of output, linked to their connection with the digital medium. The concept can also be applied in the reverse direction i.e simple interactions with the physical object can affect changes its digital representation.

Smart Objects. Adding to the functionality within objects, objects may be embedded with many kinds of sensors. These can be accelerometers, temperature, pressure, motion, pollution, humidity or bio sensors. The availability of low cost and low effort ways of augmenting objects allows users to include objects of their choice in the IoT. The Green Goose startup, for example, sells sensors in the shape of 2D stickers and balls that can be easily attached to any object. Objects having GPS can be tracked for their location. When combined with accelerometers, the object can send information about when and where it was moved.

RFID (Radio Frequency Identification) and NFC (Near Field Communication) enabled objects offer two way transmission of information between the objects and the reader. RFIDs are used in inventory management, for tracking products in stores. They are also used for animal tracking, and for payment in toll booths. NFCs are used in the ecommerce domain e.g mobile payment, smart cards, Google Wallet and for airplane boarding. Such objects enable user specific transactions between users and Smart Objects.

Smart Objects having microprocessors, being most technologically advanced, fall on the other extreme end of the Technology spectrum. Microprocessors can be programmed to implement evolved functionality. This, however, needs some degree of coding and development skills. Many hackers and DIY enthusiasts embed Arduino microprocessor in objects, so that they can update and post status, or host a web server.

The Technology spectrum can be extended to include new technologies for augmenting objects that are developed in the future. We can imagine future objects having some form of enhanced capabilities, memory, increased intelligence and learning added to them. They can be self-aware, self-correcting and context aware. Such objects can be added to extend the right (Smart Objects) segment of the Technology spectrum. The three segments of Technology spectrum support inclusion of a broader variety of objects. The Technology spectrum can also include social and perishable objects in the form of digital representations, if augmenting them with technology is not appropriate or feasible. As an idea for the future, automated cameras can capture the pictures of objects, if identified as being important or special to the person concerned.

5. Research Gaps

Through the overview, we point out that little research has been done to understand the people to people connections within the IoT. Objects that matter to people are not included in the IoT. Social objects are mostly absent from the field. We explain the two kinds of connections that the Internet of Things research focuses on i.e.

- person to device
- device to device

Person to device: These forms of connections are reflected in automation and remote controlling of devices. A person can access one's devices, or appliances in homes through smart devices. Objects provide links to information through them. They can act as mediators that collect information about their surroundings. Other examples are sensors that measure pollution in the environment, or smart meters that collect electricity usage. Objects are augmented so that they contain and send out information. Objects are tweeting their status, usage, location, history or interactions. Objects also serve as a link between users and online information.

Device to device: These connections help in coordination and scheduling of activities. An apt example is the alarm clock that connects to a personal calendar, and starts ringing an hour before an important meeting. These connections are especially useful for unplanned events and changes. These connections can provide more personalized, timely and efficient service to its users. The car, connected to the air conditioning system at home, and to the toaster, microwave, heating and kitchen equipment are examples of use in personal lives. In stores, RFIDs and barcodes are used for inventory tracking, to gather information about items present in the store and send it to a database for management.

The device to grid connections can be seen as a special case of device-to-device connections. Here, a large number of devices act together, and may send all their information to be logged and processed at a central repository. Examples are cloud computing and smart grid. An important area for object-to-object connections is sensor networks. A large number of sensors, deployed in the environment, communicate and transmit information among each other. These are used to find out and transmit information about the temperature, pressure, humidity or pollution (through various sensors for gases) in the environment. Smart grid connections are applicable to the electricity domain. Smart meters enable connections between households or industries and the grid. Specific kinds of smart meters can be connected between each electric appliance in a home, and the grid. These can log the electricity consumption at the appliance or household level, and data is sent to remote server for logging, tracking, storage and analysis. This setup can be used to inform users about their consumption, or give them feedback through displays, charts, bar graphs etc. about their usage over time. It may help users to make smarter and more efficient energy decisions. Also, appliances can be scheduled to make use of low pricing or off peak hours. For example, the washing machine can be constrained to operate only at off peak hours, or when the load on the grid is below a certain threshold demand or price. Similar ideas can be implemented to promote efficient usage of utilities like water or gas.

The person-to-device and device-to-device connections within the IoT enable new forms of person-to-person interactions. When objects around us take new functionalities, our interactions with and through these objects change. This also affects the ways in which we connect and socialize with each other. We question the current models of IoT to support objects that matter to users. I argue that person-to-person connections through Things matter, and have been given less attention.

How can the Internet of Things support the basic human need of bonding to each other?

I suggest that users will care more about the Internet of Things if IoT is designed to support social aspects, or strengthen interpersonal relationships. The study addresses a symbolic question that is relatively unexplored – How can I include my wedding ring in the IoT? The question addresses users' ability to contribute to the creation of IoT, and inclusion of social objects that matter to users. I explored the social aspects emerging in the IoT. The study looks at bonding, sharing and connectedness with friends, family and loved ones through the IoT.

Including social objects that matter to people is used as a way to explore the person-to-person connections within the IoT. The approach for many objects in the Internet of Things is derived from functional processes or supply chain management. Objects are augmented so that they can be tracked or provide efficient services. Instead of looking at objects as items that need to be tracked alone for functional processes, I explore the social aspects emerging in the Internet of Things. Rather than creating new augmented objects to support communication or sharing, I used existing gifts, and analyzed how the representation of existing objects online, supports connectedness. The study looks at the ways in which representing physical objects online help users to socialize, connect and express their emotions. The study specifically looks at cherished objects in the form of gifts.

6. The Study

To study the social aspects emerging within the Internet of Things, I designed a user study named Gift Box. The study allowed participants to choose the objects they are attached to, and include them in the Internet of Things. For this project, I restricted the scope to the basic representation of objects online through pictures. It is the model where the object has a digital representation, and all interactions with the object occur through that medium. More specifically, the study looked at the digital representation (through pictures) of gifts on a social medium. Gifts are cherished objects that represent bonds between people. I chose a social sharing platform, so that it highlights the social aspects of the Internet of Things. Facebook was used as the social platform for our study because of its familiarity and popularity.

6.A. Methodology

I conducted a user study using Facebook as a platform. Facebook is a social networking website. Each person has a Profile page, consisting of personal information and interests. After he/she has added a person to their social network, they become a “Facebook friend”. Typically, people invite their friends and family members, and add them to their network. One can update status, post and share pictures through albums in one’s profile. Another view is the Wall, where one can see constantly updated news about activities and posts from friends. Facebook allows interactions and social sharing by letting people perform activities on other people’s Wall. Specific activities that I looked at in the study are explained below.

Like: This can be done on an update, comment, post or picture. It is used as a way of showing appreciation and popularity. The number of likes on any post are displayed below it.

Tag: This is done to catch the attention of another person. Usually, tagging also sends the tagged person a notification. The way to tag a person is to write his name, or select her name from a dropdown list, or refer to the person using an @ symbol. One can tag friends in posts, comments, status updates, pictures and captions of pictures.

Comment: Any word, phrase or sentence written in response to a post.

Caption: When putting up a picture, one can name or label it. The caption is some text to describe the picture or experience, which shows up below the picture.

Post: A post can refer to a status update or a picture. One can also use posts to share a link, article, song or video. As long as privacy settings are not too restrictive, people are allowed to freely like and comment on friends’ activities. People can also post on other friends’ Walls.

Participants were recruited through snowball sampling. The study included 18 participants, with an equal distribution of males and females. A majority of the participants were students (undergraduates and graduates), with their age range varying from 18 to 30. The study was conducted in two countries, USA and India. The study style and participant demographics were similar across the two countries. As an appreciation token, participants were compensated in cash for their participation. The participants gave two interviews, and did a Facebook task for the study. The study had three parts to it.

In the first part of the study, for each participant, I conducted a pre-study interview. I asked questions about five gifts that are special to them. Participants shared the stories and memories around the gifts, and talked about the people associated with the gifts. This was done to understand why the gifts were special for them. This session roughly took half an hour. Questions about why the gift was special, who gave it to them, when did they get the gift etc. were asked. After mentioning three or four gifts, if the participants struggled with finding more gifts, I broadened the items to include “any objects that are special to you, you

are attached to, love, keep with you always or are crazy or passionate about". Thus the study included objects that participants love, or are sentimentally attached to, mostly in the form of gifts.

The second part was a **Facebook task**. The participants took pictures of these five gifts, and put them up as their profile picture on Facebook. During the course of the study, participants kept the things (gifts) they chose as their profile picture on Facebook. After the initial interview session, participants had to take pictures of all the 5 gifts that they talked about. Each gift was put up for 2-3 days, and thus the study lasted for around two weeks. Every third day, they were sent a reminder to change the profile picture.

Participants were required to display all 5 things as their profile picture during the course of the study. They could add more gifts to display as their profile picture if they wish. They could also share it with friends or family, by inviting them to share or like the picture. They were allowed (but not required) to tag anyone if they wanted to, or put captions, comments or descriptions of the pictures of gifts. During the study, participants carried on their regular Facebook activity, in the form of comments, posts, likes etc. as a regular Facebook user. I recorded all the interactions that happened over these pictures of gifts on Facebook. The Facebook activity (comments, likes etc.) around each of the gifts in the study was analyzed. For each gift, I noted whether the gift's picture was tagged or not, was provided with a caption or not, and the number of likes and comments on it.

In the third part i.e the post-study session, I conducted semi-structured interviews or focus groups. This session had questions about their experience of the study. This took about an hour. I wanted to understand the phenomena experienced by putting up cherished objects on a social media website. Participants talked about their choice of gifts, and what it meant to show them online. They reflected about other things that they would like to represent online, along with the reasons for it. I also looked at whether the experience helped users to express emotions or connect to their loved ones. The study helps us get a better understanding on the social perspective on the Internet of Things. The study let us probe the process of displaying sentimental objects in a digital space, and reflect on its comparisons with exhibition in a physical space.

6.B. Findings

In the Gift Box study, participants took pictures of their five favorite gifts. For each gift, they put up a picture of it as their profile picture on Facebook for 2-3 days. In our analysis, according to the pictures put up as part of the study, I developed five categories to organize the gifts. The categories classify gifts according to the kind of social objects the gifts are. In developing the categories, I also looked at the social phenomenon being supported by the gifts. The roles played by the gifts for the participants also influenced the category it belonged to.

The study included a total of 84 gifts, representing social objects. The study included objects that participants love, or are sentimentally attached to, mostly in the form of gifts. I labeled each gift to reflect the most suitable category it belonged to. The number in brackets denotes the number of gifts belonging to each category.

- Exhibits of hobbies (15), art (6) and achievements (5)
- Icons of important moments (16)
- Handmade and group autographed items (14)
- Food (11)
- Clothing (6), accessories (17) and gadgets (4)

Apart from the major categories, other items included soft toys, mugs, showpieces and pictures. The categories are not mutually exclusive. A particular gift could belong to more than category, if suitable. For example, a cake for a birthday party thrown by friends falls in both categories; food and an icon of important moments.

6.B.i. Exhibits of Hobbies, Art and Achievements

This category of gifts allowed participants to show their artwork, hobbies, accomplishments or other information that matters to them. The gifts were used to reveal part of a participants' identity. I discuss each of these exhibits below.

Hobbies



Fig 2. Bike



Fig 3. Color pencils Fig 4. Racket



Fig 5. Harry Potter books

The gifts in this category reflected what the participant was interested in, or the activities he/she liked. Sports, art and music were the major examples in this category of gifts. There were many sports equipment that were put up as a part of the study. Examples are badminton rackets, tennis rackets, soccer balls, pool cues, bikes (Figure 2) and skateboards. A state level player put up his badminton racket (Figure 4). Artists put up their set of color pencils and brushes (Figure 3) as a part of the study. Avid readers included their e reader (Kindle). Participants published the activities they liked doing, or showcased their talent through the gifts they associated themselves with.

Participants displayed their love for music by putting up pictures of their guitar, favorite CD, or other musical instruments that they play. Fan following of a particular favorite team was exhibited by displaying accessories belonging to the team. Two complete sets of Harry Potter books (Figure 5) showed up in the study, reflecting admiration for the series. A Manchester United apparel and a favorite music CD reflected fan following for Manchester United, an English soccer club and Avril Lavigne, a pop artist respectively.

Exhibition of Art by Known Artists

Gifts in the study were used to showcase art and talent through creations. People put up paintings that were gifted to them, remarking on "how good their friend is as an artist". A product design student put up pictures of items she had designed for a course. Beautiful paintings, murals and handmade cards reflected the talent of the artist. The emotions of pride and happiness could be seen through the act of putting up such items. Also, such creativity got additional appreciation through Facebook comments and likes. Gifts on a social network gathered recognition and appreciation for one's creations. Artists were appreciated through beautiful paintings, art pieces or handicrafts. Many gifts in this category were put up by friends or family members of the artist (as opposed to by the artist herself). Some comments⁹ that highlight appreciation of the art or creation in the study are listed below¹⁰.

"A beautiful 'mural' as a birthday gift.. Great piece of art work (as usual) by Anthony.. See the 3D effect.. Thanks a lot for this Anthony!! :)"

"One of the most creative (and hilarious) greeting card I have ever got for my birthday.. Thanks [names of six tagged friends] for this one.. :)"

⁹ All quotes, captions and data captured from the study are in italics

¹⁰ Names used (if any) have been changed to hide identity

Achievements



Fig 6. Graduation paraphernalia Fig 7. Certificates Fig 8. Medals

This category of gifts reflected pride or accomplishment. These objects were won or awarded to participants, to represent their hard work and achievements. Examples are completed projects, certificates, or trophies. Below is a comment on a gift bought from a first salary, “*a gift from the first salary is always special.. and then when its a Nike football.. :). You should have got it here in the luggage..*”

First purchases, for similar reasons, meant a lot to a person. For example, the first house or car indicated a level of accomplishment and stability in life. Some pictures from the study were graduation gifts, paraphernalia (Figure 6), certificates (Figure 7) and medals (Figure 8). A caption below read, “*This graduation gift came in the mail yesterday, sent by my amazing sister, Catherine, and her husband, Mike. They are in New Jersey right now, so it came in the mail yesterday. Love you guys so much. Wish you guys were here with me. I am definitely going to wear this the day of my graduation so that both of you will be there with me as I take my first big step into the real world.*”

6.B.ii. Icons of Important Moments

Some gifts, along with the captions, made it clear that they were associated with special moments in the person’s life. Examples are gifts for a farewell, cake for a birthday and so on. These gifts act as links to cherished moments in a person’s life. The gift was not necessarily special because of what the gift is, or its value. Rather, it symbolized or acted as a marker to memories in one’s life, hence acting as an icon to special moments.

Sometimes, these moments or events were more elaborate like rites of passage in one’s life; examples are weddings, birthdays, graduation and anniversaries. In other cases, these were special for personal reasons, but were not associated with any ceremonies or public rituals. For example, first gift by a husband, or gifts from a family trip, or reminding him of a special dinner.

The idea of “firsts” recurred often in this category of gifts—first birthday in the US, first gift by my husband, first car, first mobile phone, (or gadget), first soft toy and so on. Last gifts, being on the other end of the timeline, also hold a special meaning. Gifts in the study included items left to a person after someone had died. A piece of jewelry left by an aunt, or a family utensil handed over by great grandmother can be counted as examples. It was evident that some gifts acted as heirlooms, or as family tradition, and were passed down from generation to generation. A few captions that captured the sentiments of such gifts are presented below¹¹.

“This used to belong to my mom when she was little, and was actually given to me by my great-grandmother. Therefore, it can be thought of as a family heirloom.

Love you Panji Aaji! Miss you a lot!!!!”{grandfather grandmother}*

“a family heirloom gifted to me in her will by my neighbor-grandmother. thanks, Aai for leaving me this (this is a picture of a replica i found online) as a legacy :- can't ever forget you”{mother, a way of addressing a close and respected elder female}*

“the replacement watch gifted by bhai to replace the first watch he gave me :-) on all my best and*

¹¹ Words from another language are marked with a *. Translations are provided in curly brackets {}, at the end of the quote or caption.

important days i have always worn a watch that he has bought me”{brother}

The act of putting up gifts associated with special events gave the participant a chance to reflect on the past, on cherished memories. It also served as a way for other (Facebook) friends to know more events about the person's past. Part of getting close to someone comes from knowing more about the person, his life, past, interests etc. Gifts from special events acted as grounded pointers to reveal past events that have been special to the participant.

6.B.iii. Food



Fig 9. Birthday cake



Fig 10. Favorite fruits



Fig 11. First attempt at baking

A surprising category of items in the study was food. Food items included fruits, cakes, muffins, pizza, coffee, chocolates and homemade dishes. Food reflected pleasure and the social activities of eating together, sharing recipes, and experimenting with cooking. Participants put up pictures of yummy looking food items that were ordered, purchased or homecooked. They were treated as gifts “*when someone ordered it for me online, when I was feeling low. It made me happy.*” Food items also acted as indicators to special events or firsts (icons to important moments). Examples of food items included were “*cake brought by friends for a birthday treat*” (Figure 9), “*favorite fruit basket sent by family*”(Figure 10) and “*my first attempt at baking*”(Figure 11).

6.B.iv. Handmade and Group Autographed Items

Handmade gifts were greatly appreciated by participants in the study. These were in the form of handmade greeting cards, paintings, collage and so on. Autographed gifts also showed up in the study. Mugs, balls and shirts signed by friends were put up.

Handmade gifts reflect the time and effort a person has put in to create the gift. This makes it special and personal. A few comments on Facebook provide evidence, “*nice art work.hand made gifts are indeed special coz of the things that go into making it..*” “*hand-made gifts are the most precious, no matter how many decades go by!*”



Figure 12. Handsigned shirts

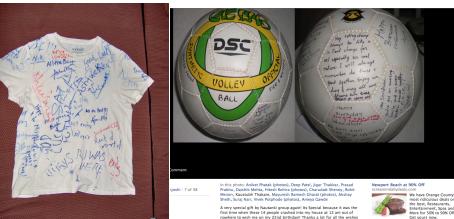


Fig 13. Autographed ball

Autographed gifts acted as artifacts reflecting shared group experience. Handsigned shirts (Figure 12) and an autographed ball (Figure 13) reflect the shared experience of a group of friends, who use the gift as a token to signify their bonding. How the signatures are placed together, in various sizes, shapes, handwritings and orientations gives it meaning. It reflects the shared ownership of all the friends who sign the shirt or the ball. One can see how the signs have been fit in together, using the, in various sizes, orientations and the space. The fact that two signatures are close to each other may also serve to signal a bond between the friends. The process of how the gift emerged to be what it is now makes it special. Digital objects (pictures of gifts in the study) very easily offered a medium for the creation and display of

shared ownership e.g. a profile page or a status update, or putting up a picture on which many friends can comment.

6.B.v. Clothing, Accessories and Gadgets



Fig 14. Footwear



Fig 15. Watch



Fig 16. Jewelry



Fig 17. Soft toys and mugs

The last category involved accessories like footwear (Figure 14), watches (Figure 15), jewelry (Figure 16) and clothing. This category also includes gadgets like mobile phone, keyboard and e-reader. We must note that electronic devices found in the study were very limited in number (only 4). Apart from the major categories above, there were other gifts (5) like soft toys, mugs (Figure 17), showpieces and pictures.

7. Discussion

7.A. User Engagement

My goal is to point out possibilities of how to engage the users in the Internet of Things, by including objects that matter to them. This study was an attempt to identify objects that matter to people. The study suggests an expansion of focus in the kinds of objects included within the IoT, not restricting to objects involved in functional processes alone. User involvement, engagement and contribution may lead to better acceptance of the IoT in everyday life. I identify three ways to enhance user involvement in the IoT-- including perishable and social objects, providing users an easy way to represent their choices and building social networks around objects.

7.A.i Ephemeral Items

Our findings about food items suggest representing perishable items in the Internet of Things. Food items were put up as a part of the study. People care about perishable items like food, flowers, plants, candles and cosmetic products. The study shows that such items matter to people, as there are friends, events and memories tied to them.

The study had examples in which the gift had broken or was lost. Participants mentioned long lost gifts from their childhood, which they remembered fondly. In such cases, participants found an online picture or replica of the gift, as a symbol for the original gift. In a participant's remark, "I do not have the gift with me, it is still kept safe in my cupboard at my parents' home." Digital representations of cherished items can serve to reflect memories, even long after the object has been destroyed.

Ephemeral items currently have no representations in the Internet of Things. The approach of augmenting the object with technology, however, does not make sense for such items. The brownie, as an example of food item found in the study that is special for a participant, cannot be augmented with sensors. Different ways of representing perishable items within the IoT should be explored. Similarly, including social objects in the scope of the Internet of Things may lead to more user involvement.

7.A.ii. Social Layer

There are opportunities to design social interactions and networks around the Internet of Things. The objects need not only be augmented to serve an efficient process, but may also connect people to each other. Many objects within the IoT stem from a supply chain management approach i.e they are augmented for efficient tracking in stores. RFID tags work well in the inventory or store for management, but their

value falls after purchase if the customer does not care for it. These tags can be used to add a social layer for the Things, to make the users more involved and interested. The next time one buys a shirt, it could have a webpage automatically linked to it, which could connect to all the parties she attends wearing it. Friends who like the shirt, or other people who have a similar taste can be connected. Amazon or store sites allow a person to put reviews and share experiences about a product. However, the ways to link them to existing physical products in the world are weak. Ways to include existing items from the physical world in such networks are not well supported.

For example, the Dominos store already has a tracking infrastructure built around the pizza delivery mechanism. One can see whether the pizza is in the oven, being baked, or is out for delivery to the consumer. Why not extend the idea to include a “Pizza space”, a digital representation for the pizza. As soon as one orders a food item online, a digital space to share memories around it are automatically created. People could post pictures, share experiences, recommendations and discussions, plan future events, around the pizza. The site may support creating events around the common interests. They could link it to the place, event and people involved. Here, the pizza is used as a symbol for a social object. One can imagine that various social networks can be built around objects that people care for, and have memories or sentiments attached to. The study highlights possibilities to build tools that support interactions, expression and bonding around Things. Networks built over the IoT can provide people the opportunity to express their social interactions around objects.

7.A.iii. Users' Choices

Using pictures is just a simple (limited) first step to exploring new kinds of objects in the Internet of Things. This paper does not suggest that the research areas of the Internet of Things and Social networks (having pictures of objects) are the same. Instead, I used pictures in the study as a way of representation, to identify the objects that matter to people in the Internet of Things.

To engage users in the IoT, users should have easy ways to contribute to creation of the IoT. By having more objects in the IoT that matter to users, they may feel more involved. The study identified some objects that users would like to include. Researchers in the IoT need to think of ways to support the inclusion of such objects. Making the object “smarter” by putting more and more technology may not be the only way to proceed. Furthermore, it may not even be feasible for some objects. We need to carefully look at the kind of objects being included, and then choose a suitable point between augmenting the object and its digital representation accordingly. If the IoT has objects that people care about, people will care about the IoT more. For users to be able to represent their choices in the IoT, they should be given easy ways to represent objects of their choice. Here I refer again to the Technology spectrum as a tool to understand and support user participation in the Internet of Things. Placing augmented objects on the Technology spectrum can provide a visual understanding of how easy it is for the non-technical user to include the object. Objects on the digital end of the spectrum currently have better support mechanisms to be put up by non-technical users. Arduino and DIY electronic kits support user involvement in making interactive objects. This paper highlights the need for ways to make it easier for users to contribute objects of their choice.

7.B. Showcasing Handmade Creations and Artwork

It was fascinating to see so many handmade gifts and collectively autographed items in the study. Even though the study had a small sample size, handmade gifts had a considerable presence. The study highlights the need to think of ways to support showcasing handmade creations and artwork. Creators and artists reflected a sense of pride, creativity and talent through handmade creations. When gifted to someone, handmade artifacts were deemed to be special, as they were especially and exclusively made for him. The creation reflected an intimate familiarity and bonding. In a participant's remark about a handmade artpiece, “*It shows that she cares for me enough to put in the time and effort to make a gift.*” These gifts rendered themselves to evoking a sentiment that was different from buying a standardized commercial product from the market. Participants expressed a sense of pride in displaying the talent and creativity of their friends, by putting up paintings or artwork made by them. Our study highlights the need for tools to support the display and advertising of selfmade creations. Participants in the study shared and advertised their art. It acted as a

way of showing appreciation for the artists. Displaying handmade creations led to sharing of ideas, inspirations and appreciation among participants and their friends. The findings suggest building social sharing tools around Things to support display of creations and artwork. The ideas can be applied to paper crafts, paintings, origami, embroidery, handcrafted items, sculptures, artwork, decorative showpieces and self designed products. I discuss four design considerations that were highlighted in the study through handmade artwork, creations and artifacts. These considerations can be used for designing social sharing networks around objects, digital objects, and tools to showcase handmade creations. Digital representations of handmade creations may support enhanced attachment if they reflect their history of creation, shared ownership and a “personal touch”. The four design considerations are i) personalization and flexibility ii) support to remember, share and forget iii) reflect history of creation and iv) shared ownership.

7.B.i. Personalization and Flexibility

Our findings show that gifts that display a sense of personal touch are special. Perhaps we can think of ways to add this “personal touch” to digital objects. Providing ways for users to personalize digital objects may enhance the sentimental value associated with them. Embellishments and decorations that can be added to gifts give it a personal feel. A personalized engraving on an ipod touch, put up in the study as a gift, may be seen as a first step in this direction. The gift was seen as being “cool”, and at the same time “*exclusively meant for me, as it has a loving message by my hubby*”. Another personalized artifact in the study was a gifted mobile cover, having a picture of the participant with the friend who gifted it. Digital artifacts offer limited flexibility and ways of personalization. Social media offer a very structured way of posting content. Playing with fonts, styles and colors as ways to indicate the creator can be explored. For example, there are Facebook apps that publish the song one was listening to, the article or book being read, or how much one ran or exercised during the day. The fixed structure and regularity of the updates makes it monotonous, and hence less appealing to the audience. They do not offer much choice for the structure of updates. The updates are periodic, and are set in a rigid structure. Providing more flexibility and personalization opportunities can make digital entities more interesting for the audience.

7.B.ii. Support to Remember, Share and Forget

In the study, participants mentioned gifts that were special, but they no longer had the gifts with them. This was due to reasons like the gifts were broken, lost, at a different place, or in another home where the person used to live before. They mentioned gifts from their childhood, which were kept safely (or sometimes participants were not sure where the gifts were anymore.) For such gifts, participants found a picture from the internet, or replicas of gifts and put their pictures up online. In some cases, they found an alternative object, something that was pretty close to the gift, or reminded them of it, and put it up as a replaced gift. This sentiment is reflected in the comment, “*hmm.. this is just a representation.. the one my friend painted was close though.. it was long back and its in India.. unfortunately, couldn't find a pic of the original...*“ This brings our discussion to issues of permanence, decay and loss of objects.

People create memories of events through physical tokens, ephemera or memorabilia. Carefully preserving the brochure of a concert, or the tickets of a special train journey are common practices. These are ways to materialize the memories of an ephemeral event. Presently, we do not have rich ways of creating similar memories in the digital space. Also, we do not have infrastructures or practices that support sharing memories with digital objects. Archiving and displaying cherished objects in homes leads to visitors looking at and talking about the object. One can open up a scrapbook with family members and friends, and relive and cherish moments from the past. Another quality of physical objects is serendipity i.e accidentally stumbling upon gifts. One accidentally finds an old gift while cleaning, or in a hidden away box. Digital memories do not offer similar practices of stumbling upon memories. Also, we may need to think of gradual decay of items. Losing objects with time makes way for other memories. It lets us gradually forget things. After they are lost or destroyed, people still remember them. The issue was seen in the study, in cases where people found replicas of gifts or pictures of similar stuff online, to represent the gift that was lost or destroyed.

7.B.iii. Reflecting Creation

Sharing the many versions of creation during a piece of music or digital artwork can enhance the value of cherished digital objects. As seen in the example of a shirt signed by friends, value is added to objects if they reflect their history of creation. Sharing or displaying the many versions created in the process of developing the music piece or digital artwork can provide the richness for the digital object. We can explore representations of handmade artifacts that offer a richer history of its creation, or ones that store and reflect the stories behind and during their creation. The persons associated with the creation should be able to create together, remember, revisit, exhibit, and share the sentiments involved in making the artifacts. Playing with various styles, colors, and innovative methods that retain the individuality of the persons associated with the gift can be experimented with. A handwriting or signature is an artifact that is unique to each person, and is captured and reflected when a person writes or signs the gift. Digital representations of artifacts may be developed to retain and exhibit this uniqueness of the persons involved.

7.B.iv. Shared Ownership

The Facebook page for a gift emerging from the study, can be seen as an digital entity. A digital entity is an emerging, constantly evolving artifact on a digital medium. Digital entities can emerge from the contributions of many people. They lend themselves well to a feeling of shared ownership. Even though it is one person who puts up a picture on Facebook, friends can tag, comment, like or share it with others. Thus, the final entity emerging out of all these interactions on Facebook is treated as an evolving digital entity, it no longer belongs to the person who put up the picture. In the study, shared creators often included the owner of the gift, the gift-giver, friends and family members associated with the gift or the event related to the gift. These people were not necessarily explicitly tagged in the page. However, their presence can be seen through their activities, interactions, comments, likes and tags.

The Facebook page with the picture of the gift reflected the feelings, activities and interactions of all the people involved with the gift. It can be seen as a digital artifact that acts as a token reflecting a group shared experience. (similar to a physical token like a shirt signed or collage made by all friends). A digital entity is continuously evolving, as it can change its form, include (and remove) more content, and keep including new members.

Online representation of objects allows people to create new digital entities. They can even be manipulated to reflect memories as they would “like to be remembered”. An example was seen in the study, where someone included a friend from the group, who had missed out on the event. Inspite of his absence, he was tagged in the picture of the gift, alongwith other friends who were present during the cherished moment. *“He missed out then, but tagging him here...will kinda let him know..that he was missed..actually more than that..it’s like we can still make him a part of it..you know..like by having him here atleast.”* The comment reflects a vague feeing of inclusion and manipulation of digital entities according to users’s wishes. The comment reflects the inability to change memories of the past; yet digital entities allow the creation of new and modified memories of events.

7.C. Privacy, Authority and Ownership

The study involved digital representations of physical objects in the form of pictures of gifts. Gifts, by definition, tend to involve more than one person i.e the giver and the receiver. Also, many gifts in the study were gifted by a group of friends, thus having more than two persons associated with them. Adding to the feeling of shared ownership, was the fact that the gift was put up on a social media website. Many people can like, comment and tag on the pictures of the gifts, hence rendering a feeling of shared creation and ownership. The study highlighted that with all these factors, the issues of ownership, authority and privacy become complicated.

Putting up pictures of shared objects conveyed a special meaning to the group of people involved with the gift, or during the event. Items were put up in the study, which *“have a special meaning for our group. No one else really understands the significance or secret of the gift. To the outsider, it is a regular soft toy. No one knows about the prank it reminds us all of (with a giggle).”*

This raises questions about ownership and privacy. Physical objects have clearer and more visual indicators linked to them to indicate ownership. A person needs to physically enter the space (where the physical object is kept) to tamper with a physical object. Also, the actions with the object are visible. However, on the digital medium, who does the artifact really belong to? Does it cease to become one's property as soon as she decides to publish it online? Relevant to the study, other actors (Facebook friends) had the capability to like, comment and create a new digital entity for the object.

How does one indicate ownership on a digital medium? If needed, what are the ways to restrict unwanted people away from the artifact? Privacy settings of social networks seek to address these issues. On Facebook, one can restrict the post and profiles to various privacy settings. Three settings that Facebook currently offers are public (everyone can see and post), friends, and custom (friends of friends specific people or lists, only me). These refer to the privacy settings during the time of the study. I must note here that privacy settings on Facebook keep changing. This reflects the challenges, concerns and efforts of social networks to suit the changing attitudes and expectations of users regarding privacy.

An interesting case was of a guy who refused to participate in the study. He said, "*I do not accept the friend requests from people I don't want to, under the pretence that I am not very active on Facebook. Even though I login often, I am not very active in posting and commenting on stuff, so most people can't find out, unless they are really stalking me. The frequent change of profile pictures would be a clear indicator that I am lying, and I don't want that..it would be awkward you know..like saying..I know you..but do not want to be "Facebook friends" with you.*" He mostly did not accept requests from family members, as he thought many pictures that he is tagged in, are not appropriate for his family members to see. "*they wouldn't say anything maybe..but still wouldn't appreciate my actions (of wild parties for example). Why create such a situation when you can avoid it?"*

I observed a few instances of people removing pictures of gifts after they had put it up for some time, or after the study. One participant dropped midway through the study, because he stopped using Facebook at all. Although limited in number, but post-interview discussions brought up issues like what is allowed to be represented? Who has the right to put a picture of the gift? Who gets to decide whether it is appropriate to be included or not? What are the ways in which people can resist the representation, or suggest alternate ways of representation? Who has the rights to express discomfort and resistance?

Another conflict observed in the Facebook interactions of the study was about someone requesting the participant to bring down a picture of a collage. The collage was made by a group of friends, and had their pictures in it. It was fine for the picture to be in the collage, probably because of the limited audience, while putting it up on a social media made him uncomfortable. This highlights the issues of audience and display on a large social network.

These instances highlight the conflicts regarding authority and shared ownership. Although a digital identity is created, shared and viewed by so many people, the rights to remove a post are only with one person. The person who put up the post is designated as the sole authority to remove or modify the post. Also, he can manage the privacy settings, and restrict the persons who can contribute to the post of the picture. In the study, the options that other people had to express discomfort are untagging from a post, or unfriending the person. Stringent extreme options like report as spam, or report as offensive are rarely used by people (never observed in the study). Moderate and subtle ways of expressing reluctance, disagreement, resistance and objection should be supported in social networks. The above examples show how people manage issues of identity, performance, authority and privacy on social media.

8. Limitations

The sample size of the study was too small to make any statistical claims. Although the study was conducted across two countries (USA and India), it was not intended to be a cross cultural study. I did not find any major differences in findings across the two sites. A couple of reasons for no strong differences can be the similarity of demographics of recruited participants. Almost all participants were well-educated students or professionals, with sufficient exposure to global culture, practices and social networks. The overall activities of tagging and putting captions on pictures seemed to be less observed in India. However,

I cannot make any definitive claims due to the small sample size. There were a few instances in the study that could be counted as cultural references. A few words or phrases from languages other than English that are particular to a specific community were used. In our study, we found the use of two other languages, apart from English.

The findings could be biased because of our choice of a popular social network. One participant mentioned that his choice of gifts was affected by the style of the study. The study asked participants to put up pictures on Facebook, which involves a large audience. He pointed out that "*there may be other gifts that are special to him, but he did not mention them for the study, either because they were not appropriate, or too personal.*" Also, existing Facebook practices of putting up photos and conventions of photo sharing could have influenced the study.

9. Conclusion

The study combined existing cherished objects and their digital representations. I discuss the idea of Hybrid Entities on the Technology spectrum, where a digital representation of the object is closely linked to the physical object (currently possible through the use of 2D codes that support links to the Internet). I highlight the current focus of the field of the IoT on technology and communication. With such a focus, the IoT includes many more objects with the motive of tracking and supply chain management. Our study, however, suggest that the social aspects of the Internet of Things matter to people. Instead of looking at objects as items that need to be tracked for functional processes, designers should explore the sociality emerging around the Internet of Things.

This paper points out that it is important to understand the people to people connections emerging in the Internet of Things. Tools that support interactions, expression and bonding around Things may be helpful for enhanced user involvement in the IoT. Increased user engagement in the IoT can be achieved through inclusion of objects that matter to users, providing users easy ways to contribute to creation of the IoT, and supporting the social practices emerging within the IoT.

The Gift Box study, including gifts as social objects within the IoT, was conducted to explore interpersonal connections supported within the IoT. Our study highlights that certain kind of social objects have traditionally been ignored in the IoT. The study highlights that users care about social, cherished and perishable objects. Two interesting categories of social objects found in the study were food and handmade creations. The study identifies some objects that matter to people, and shows how current models of the IoT are not suitable to include such items. In fact, most of the objects found in the study do not even appear in the imagined Internet of Things visions of the future.

10. Future Work

For this study, I used pictures as the way to represent objects online. In future projects, I would like to explore a stronger link between the physical object and its digital representation. Instead of augmenting objects with sensors or microprocessors, I can explore objects having QR codes. These can provide the link between the physical and digital, and reflect changes on the digital medium, as and when interactions happen with the object. Most people have their cellphones with them all the time, so providing an easy mechanism through mobile phones may be useful. Users can use the camera in the phone to take a picture of the object. The phone can also provide time and location (geocoordinates) data for object creation. A smartphone application can be built, that lets users augment any object of their choice. One can take a picture with the cellphone camera, and instantly get a QR code for the object. One can stick it to the object to act as a marker. The app would also create a webspace for the object. The next time anyone scans the code, it redirects to a webpage (ThingPage) for the object. The camera can add date, time and location information to the object. Also, updates about who is interacting with (or scanning) the item, when they did it, where and when did it move, where is it now etc. can be posted. This may be extended to use sensors or microprocessor kits (like Arduino) for further processing and intelligence. A similar idea can be used to reflect the development history of an object, for example, a yarn to a knit sweater. Handmade objects can be tagged in such a way to reflect the stories and versions during their creation. I would like to understand ways to enhance user engagement with the Internet of Things.

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