

Compelling Use Cases for the Internet of things

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Keywords: Social network: virtual team: virtual organization: non-traditional organization: spontaneous and networked organization.

Abstract: Internet of agents are an emerging technological development lacking sufficient teleology. This paper aims to delineate compelling categories of application. We wish to promulgate environments for fostering research in socially aware agency for eclectic teams of humans and machines.

1 INTRODUCTION

Google has launched a campaign called Brillo, designed to allow other companies to program and compute their devices using Google's software technology. Google's Weave is designed for devices that use Weave to also communicate with android devices. Weave uses less ram and will take up less space than its android counterpart. Whereas in the cellular device market the push right now is for more powerful devices with more space, Google Brillo is meant to make tiny applications, highly efficient, very fast.

Recently, it has been suggested that things in the internet of things (IoT) framework be modeled as agent entities (Yu, et. al., 2013). In sharp contrast to passive view entities of things, agent things are active and may take action proactively. Although there are reported architectures [3][4][5] [7], they are at a high level and much of current literature in this area is a call to arms to develop agent based platforms and technologies in order to accommodate seamless interaction between things and humans.

Thing agents must be aware of their environment and must reason about others as peer residents of IoT. Part of this awareness must be when agents account for humans in this inevitably mixed teams of humans and active things. There are conceptual suggestions for accounting for sociality [3][7]. However, a more in depth exploration of sociality is lacking.

2. Social Network of Things

There have been numerous suggestions that things in proximity form social links creating social networks. Minimally, things provide profiles that include goods and services relevant to other things. [6]. Hence, we will refer to them as Social networks for IoT (SIoTN).

SIoTN are predominantly formed for a few common purposes. Chiefly, they are (a) to expedite access and use of goods and services by members of the network (e.g., locating and using a printer), (b) maintain and monitor a pattern of interactivity (e.g., caravan travel of a fleet of automobiles), (c) to achieve a shared goal or a common charter (e.g., detecting faulty components in a complex system). Invariably, multiagent protocols and algorithms are immediately useful.

In the case the beneficiary is a single node, a variant of contract network is applicable where the node initiates a call for assistance, collects bids for help, and chooses assistance from appropriate sources. When the concern involves multiple nodes, a system of work needs to be established that best address the needs. The requirements (or desiderata) can be expressed by one or many nodes that spawn a working group we'll generically call an organization. Such an electronic organization will dwell on the SIoTN. The socially networked IoTs can be considered to be the background fabric on which the in situ organization will appear as a splatter satin

(Figure 1). We have developed conceptual frameworks for these electronic organizations [1][2].

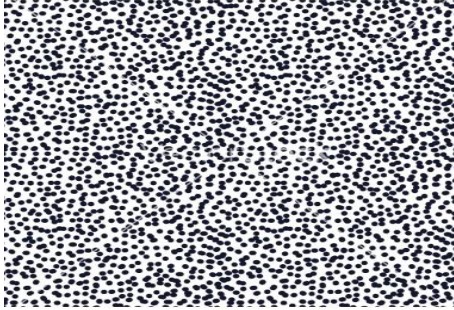


Figure 1. A depiction of prototypical IoT nodes that are formed over the background social network of IOTs.

3. Compelling IoT Use cases

A case for the three Ds—

Many routine tasks are dirty, dull, or dangerous (dubbed D3). Cleaning and maintenance of heavy machinery in a factory and tracking the public restroom cleanliness are dirty task example. Replenishing pet food and water bowls are dull tasks. Opening food can lid can be a dangerous task. In the household, feeding and cleaning after pets and children, taking out trash are other D3 examples. Surely, smart Wifi enabled gadgets will simplify D3 tasks. Things need to be social mainly to meet the possibly changing required D3 standards and report them as specified. Things will communicate the latest required demands installed by the authorized user.

A case for contingencies—

Unlike D3 that happens routinely and expectedly, security and emergency plans are often unscheduled and unexpected. Contingencies are actions designed for what if scenarios. Things must be vigilantly ready. For example, a secure door must detect unauthorized entry by a person entering a house or an animal such as a pest entering a room and must alert the authorities as needed. Rapid evacuation plan for fire safety is another example. Surely, smart Wifi enabled gadgets will be useful for activation in such tasks. Things need to be social mainly to meet the possibly changing required contingency plans and deploy them as specified. Things will continually communicate the

status prior to activation and execution steps of a contingency plan once activated.

A case for improved efficiency—

Many routine tasks such as a commute to work are inefficient on road traffic. Time is wasted on congested roads, in parking lots, excessive driving, excessive braking, hunting for parking spaces, avoiding walking people and pets. Wifi enabled vehicles, roads, parking spaces, pets and pedestrians are useful components when they form a socially communicating network with competing multiple goals of safety and efficiency each paired with specific measures. Each thing would announce its measure corresponding to its goal while others will moderate their actions in order to meet those needs. This will contribute toward a city where public transport and the grid are smart. The efficiency for this case is derived from social cooperation of things that belong to the public and not a personalized gadget or productivity app for one person featured next.

A case for personal productivity—

Each individual's personality creates patterns of interaction that at times are at odds with that person's long term objectives. If all of a person's wifi enabled devices (e.g., smart phone, car, household appliances) and apps (e.g., apps on wifi enabled devices such those provided by mydevices.com) shared personal preferences along with the person's health, well-being, and productivity, it is possible to automate and streamline routine functions for a more coherent and efficient outcome.

4. IoT versus Open Systems Interconnect (OSI) Model

Open Systems Interconnect (OSI) model is a seven layer hierarchy describing how data is transmitted in a computer network. Things in IoT are simultaneously two entities: (a) real world objects possibly interfacing with human users and other things, (b) communication nodes of a computer network and abide by the OSI layers. As real world objects, things are enhanced with with contextual awareness and decision making as well as qualities such as autonomy that qualify them to the proactivity status of agents. The agent ascription of a thing is akin to mind of a machine. Agents (aka minds) are intangible (i.e., virtual). An IoT system is both

physical and comprised of agents. A smart city can be considered to be a collection of IoT systems servicing many goods and utilities for occupants of a city, which is a population of humans, machines, (and their agent counterparts). Agent consideration is a logical overlay link layer atop other OSI consideration of communication. The logical interpretation can be extended to a group of agents engaged in interaction with common enduring objectives forming an organization, which can be considered to be virtual as well. Institutions and societies are yet larger in scope and virtual. Virtual entities will never surpass real world physical things but only extend them with meaningful conceptions.

IoT for VANET is a perfect use case that combines prior use cases. Cars and human drivers are all physical entities accompanied by driverless agents and the vehicle ad hoc networks forming VANET communication networks. There are multitude of transportation, traffic, and driving objectives shared among VANET agents. Avoiding collision and near miss among cars is an objective. Obeying all driving rules and regulations is another objective. Efficiency of traffic and avoiding congestion is a transportation and traffic objective. An IoT of VANET may have dirty, dull, or dangerous objectives as well as increased safety objectives as is the case with driverless cars. Contingency and productivity could also be objectives for a VANET.

5. An Envisioned Vehicular IoT Case

An envisioned vehicular interaction is to install wifi enabled devices in vehicles, in road segments, in road intersections, and in train carriages. Vehicles will report to their inhabiting road segments about whether they are entering or exiting from the specific section of the road. Cars will report their direction and speed of movement. At the intersections, roads segments will report to corresponding nearest intersection with the number of cars on that road segment and the vehicle speeds. The road segments will also report lane closures or other abnormalities that would alter "normal" traffic flow. Similarly, a railroad crossing will report to nearest crossroad intersection if there is a train using that crossing. Intersection stations will communicate with other intersections about the number of vehicles headed in their direction.

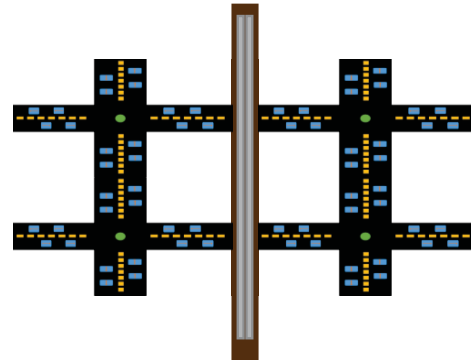


Figure 2. A typical set of intersections, road, and rail segments

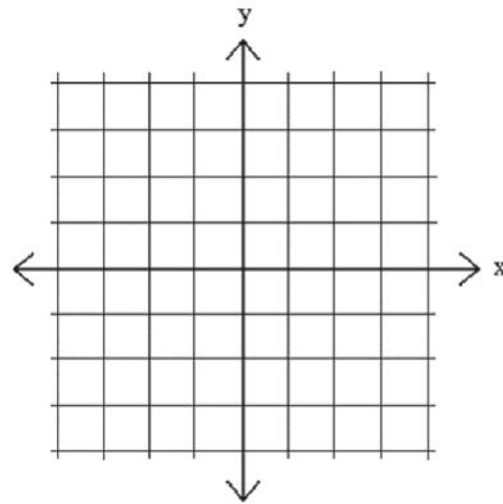


Figure 3. A typical roadway intersection

A scheduling algorithm will track request to use the intersection and will sequentially permit intersection use. This is the vision depicted in Figure 4.



Figure 4. A typical busy intersection full of vehicles.

6. Conclusions

Clearly, Internet of things is a technological leap and with that requires a sober roadmap for categories of research and development spanning allied disciplines including computer networks, social networks, smart electronic devices, and multiagent systems

Initial stages of IoT must establish standards and protocols for communication and interaction. Beyond that, we will need to incorporate methods from varied engineering, social, and applied sciences. We have delineated a few compelling use cases chief among them vehicular ad hoc networks. New York City has over half of its 12,460 intersections controlled by a centralized computer network, and other cities such as Toronto are closer to 83% coverage. Intersections control is one of the most promising application areas for IoT.

Acknowledgement. A group of my students implemented prototypes of vehicular use case in Python described in section 5 in a course during spring 2016.

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