

Social Pal: A Combined Platform for Internet of Things and Social Networks

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Abstract—Social Internet of Things (SIoT) is a new model that has integrated into two technologies, Internet of Things (IoT) and Social Networks. The SIoT defines as a social network of objects that are not only smarter but also socially conscious. The major issues related to IoT are; communication between the objects, service composition and service discovery. To address the after-mentioned needs, this paper proposes a possible approach named social pal. The social pal collects and provides the information to the IoT, and hence our proposed social network provides glue to allow the human to device interaction. This study leverages the social relationships among the participants (devices and users) in the system for delivering the required services to the users. By using this platform the capability to select and find the devices, discover the services in the IoT paradigm is augmented. Briefly, the main features of social pal are; create an object, define the relationship, find and discover the pairs of objects that can offer services, etc.

Keywords—Internet of things, Social internet of things, Big data, Data Science.

I. INTRODUCTION

One of the most important research areas of the future Internet is the Internet of Things (IoT). With the high potential to positively impact technology development in IoT physical objects are connected to the Internet using sensors and actuators[1]. There are numerous applications of IoT, such as smart cities, smart homes, and smart healthcare, etc. In fact, in these applications, a variety of sensors and smart devices used to send and receive data about the real world to the internet. The smart object is a thing, device, sensor or embedded device [2]. The smart object has the ability to communicate. It can be identifiable and sometimes, it can be able to communicate. A few examples of smart objects are smartwatches, and clinical devices etc. These devices keep growing exponentially and by 2020, they will increase up to 50 to 100 billion [3]. The challenge of IoT is to define and understand the structure of connection between humans and objects. However, in web of things (WoT) the content is being defined by the objects. For that reason, the interactions and the influence over our lives is an open issue. In addition, some other open issues are; heterogeneity, availability of different standards, and communication protocols, etc. Thus, in order to solve these issues, the Social Internet of Things (SIoT) is designed. The SIoT is a new model and has integrated two technologies, IoT and Social Networks. The SIoT provides a platform for social networks, i.e. Twitter and Facebook etc. Recent research examined in [3], shows that

the sensors present in the network along with the peoples and therefore it forms a social network. This important point figures out the evolution of objects and their relation to IoT. This provides a new way to the blending of IoT and social networks [2]. The SIoT enables one person to share his services with his neighbors. In SIoT, every object in the network is capable of creating social relationships with each other according to the certain rules provided by the owner[1]. We already knew that the billions of attached devices generate a large amount of data in IoT. So, the scalability issue arises. In order to overcome this issue, the navigability of devices is introduced [1]. The objects in a social network are capable to create, retain their local relationships and thus create a group of devices. Additionally, each device can produce and consume the service. As the SIoT is a new area of research, hence several attempts have been made by the researcher's community to develop the architecture for SIoT. There are few examples of SIoT platforms such as a prototype of SIoT discussed in [4, 5]. As stated earlier a large scale and social networks are very popular nowadays, then there is a need to develop new models for the analysis of real and large scale networks. The key requirement for the development of new platforms and models for SIoT domain is given below:

- The research on SIoT domain is still going on and there is no such standard platform available for the social networks. Thus, it is necessary to introduce the middleware for the realization of SIoT.
- The existing platforms have an inflexible structure [6].

In particular, the aims and the objectives of this study is to introduce a general platform for the SIoT environment. Our novel contribution to the research community is given below:

- We presented a possible platform for the IoT, which includes the functionalities required to integrate things into a social network.
- We identify the right policies for the establishment and the management of social relationships such as social object relation (SoR) and ownership object relationship (OOR) between the objects, in such a way that results in the social network is navigable.

The advantages of our proposed platform are given below:

- The social pal can; creates an object, define the relationship, create a group of objects having the same features, etc.

- Our platform provides a flexible structure. As it connects humans and things together.

The social pal is designed for social networks but it can be used to address the issues and the challenges of IoT. Our approach differs from the literature for this major reason.

- In this study, we are interested in the finding of relationships among the things and the owners both.

The rest of this paper is organized as follows. In section 2, we discussed current platforms used for social networks. In section 3 we presented our proposed platform. In section 4, we discussed a prototype from a use case. Finally, section.5 offers the conclusion of this paper.

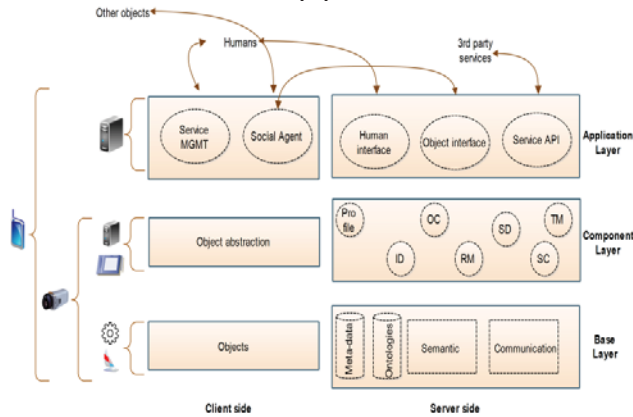


Figure 1. Architecture for the SIoT

II. BACKGROUND

A. Current Social IoT Architecture and the Platforms

We refer our readers to a recent study and thence giving a social structure to IoT networks [7]. The authors suggested a layered model as shown in Figure 1. In this figure, the left-hand side represents the client-side model and the right side as a server-side model. The server is divided into the base layer, component layer, and the application layer. The base layer provides storage space for data along with the relevant descriptors, and the semantic engines for communication. The upper layer is named as a component layer. It used for profiling and relationship management. The application layer is used to provide an interface between the objects and the humans. On the client-side, the first architectural layer is named as; objects layer. In this layer, the location of physical objects is discovered by using a special type of interface. The upper layer is the service management layer. There are two kinds of operations performed in this layer, i.e. service management and social agent. The service management is used for the controlling of object behavior. On the other hand, the social agent provides a way of communication between the objects and with the SIoT server. Pruthvi et al. in [8] presented the concept of a smart college environment in SIoT. The proposed solution is based on the enrolling of a fresh student into the college. The proposed solution lack providing the trustworthiness management and the service composition features etc. [9, 10, 11].

III. SOCIAL PAL ARCHITECTURAL PLATFORM

A. Components of Social Pal

The objective of this study is to provide a general platform for an organization such as a university etc. Our architectural model is based on earlier studies [7, 8]. In our proposed model, each object has the capability to create a relationship with others, either individually or in a group of objects which have similar interests. These physical objects may be a mobile phone, desktop computer, scanner or printer, etc. as shown in Figure 2. These objects can establish a relationship with other objects such as object-object relation (OOR) etc. The users in this network are professors and students etc. According to this scenario, the components of social pal is shown in Figure 2. In this figure, the relation between the objects and the user inside of that network is shown. Two small groups of people are shown. Each group shows a strong association between different classes, the association between the professor and student is represented by user- user relationship, etc. In addition, the association between the user and the object is the user -object relationship.

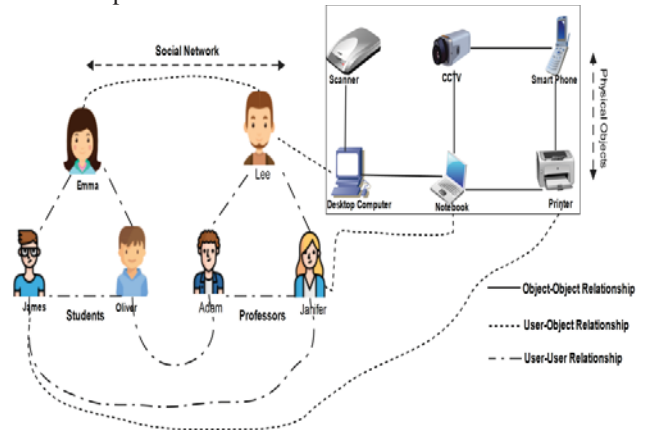


Figure 2. Components of social pal

B. The General Architecture Design of Social Pal

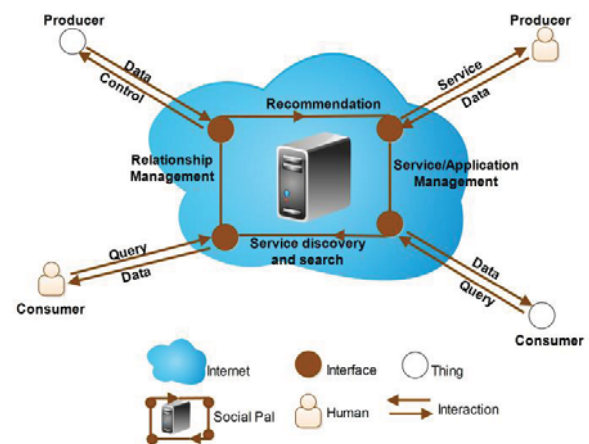


Figure 3. General platform of social pal

We discussed briefly the components of our proposed platform in subsection 3.1. In this subsection, we discuss in detail how these components interact with the proposed model. Figure 3 is the general platform of a social pal. The first component of social pal is known as an actor. An actor is a person who interacts with our proposed platform. The human actors are professors and students, etc. The second component is the social pal. It is used for the discovery and the composition of services for objects in the network. The third component is termed as an interface. The actors can make new connections by using this component. The fourth component is the internet, which provides an open access connection to all entities used in that platform. The detail of each component is given below:

3.2.1) Actors: The Social pal platform suggests a democratic platform; in which the things and the humans can take part equally by publishing the data and receiving the commands for managing the data being processed. The data is represented in the system by using simple responses to queries sent by the attached devices or users. In addition, the queries are used to find the required service for a closet object, etc. It results in terms of receiving the services from specific devices or recommendations etc.

Example: Suppose that when a professor applies a query request message to the social pal in order to receive the printing or scanning services. If the requested service is not available at a time alternatively, he can receive a recommendation in response.

3.2.2) Social pal: The social pal is responsible for the discovery and the composition of services for objects in the network. The process of social pal is; application management, service discovery, and search, recommendation, relationship or context management, etc. The details of each element are given below.

3.2.1) Service discovery and composition: the first task of the social pal platform is to find the number of services that are available for similar objects. In service discovery, the query is made to find an object or neighbor object for the service.

3.2.3) Recommendation: The social system provides a recommendation of service if it fails to provide the required service.

3.2.4) Service or Application Management: During the discovery process, the relation between different objects is identified. Hence, the trustworthiness between these pairs is at different levels and is used to select the most reliable ones.

3.2.5) Relationship Management: The relationship management (RM) is used to find the relationships between the attached objects and the actors in the system. There are two ways in which the objects can create their own social relationships. The first one is known as a profiling relationship and the second is known as a dynamic relationship.

3.2.5.1) Profiling relation: The relation is generated based on the profile information of objects. Same as humans objects possess co-location object relation and co-work object relation. These relations are performed when they shared in public or workplace experience etc. For example; when devices such as printer constantly placed in the same

place. If the objects owned to the same user. The relation is known as ownership object relationship (OOR). The objects communicate with others. If a group of devices has similar objects or built by the same manufacturer. Then the parental object (PO) relationship is applied. The example is a print request in the network.

3.2.5.2) Dynamic relationship: The relationship is created when a user or object interacts with each other based on certain rules. These friend devices are known as social object relations (SoR). If a device is authorized, then it exchanges the social profile which is similar to the peoples that already exchanged their contacts such as an address or phone, etc. The objective of SoR is to find the related features such as profile etc. These rules defined by the object owner, as a result, the objects can behave in a desired way.

3.2.3) Interface: the interaction with the actors and devices is performed by using the interfaces. The interface enables the input data and the query request. In addition, it provides the requested output, such as to request services and the control commands, etc.

3.2.4) Internet: The internet is used as a way of communication between the system and the attached devices, such as a printer, scanner, etc. Additionally, it is used to bring smart devices with their services to the user and for that reason, it allows the entire system to interact with the attached devices and provide a number of services.

C. Use Case and Sample Application Scenarios

In our scenario, the objects are the devices that are deployed in the same geographical area. The objects can create friendly relations with each other and exchange valuable information about the IoT. Figure 4 demonstrates the device identification process. When a new object named device.2 comes in an existing network. Initially, it tries to connect with neighbor unknown objects. The new object will find the social relationship with other devices having the same object configuration and try to fix the problem by using features such as OOR, type, and location, etc. Finally, a permanent link is established after the successful exchange of API keys. Figure 5 provides a sketch of a sample application use case. The complete scenario is described below:

1. James bought a new MAC notebook and just enters in the university library. Initially, the library is a jumble for him because of connecting his device with some other devices such as a printer, fax, and PC, etc. The appeared devices to him not to be exactly MAC friendly. The connection is established according to the social relationship with other MAC devices in the same local area network (LAN) as shown in Figure.4. In fact, the topology, brand, and the class object features are helpful to identify the right friends in the community.
2. Professor Adam is on his way to Yeungnam university. He lives near to the university campus. Unfortunately, due to heavy traffic and his strict class timing makes his university visit problematic. However, by using social network his car is able to get the traffic jam information in advance. On that

account, his car knows the best possible route to university and chooses the optimal path within his strict class schedule time. The finding of the right source of information in this social network is easy for a car by contacting the friend devices by means of c-location relationships. We mean that the car such as Professor Adam shares information such as; best route in the past etc.

3. Emma has many friends in different departments of the university. We suppose that Emma is a regular traveler in our social network. In this regard, she needs a regular network to contact her friends. In that case, her smartphone is a member of the university social network and wherefore able her to gather the information from different surroundings departments that are covered by strong signals, by a less congested UTMS cell and free Wi-Fi, etc. In this scenario, the right friend devices are found by looking for specific member categories such as smartphone, PC and geographical location, etc.
4. There is a number of sensors installed in the university, i.e. temperature and humidity sensor, etc. These sensors provide key information about the status of an environment in terms of the temperature inside of the rooms and the outside as well. These sensors exchange the friendship between the controllers of Professor Jenifer's room. In this way, Jenifer examines the current environment status easily in her room.

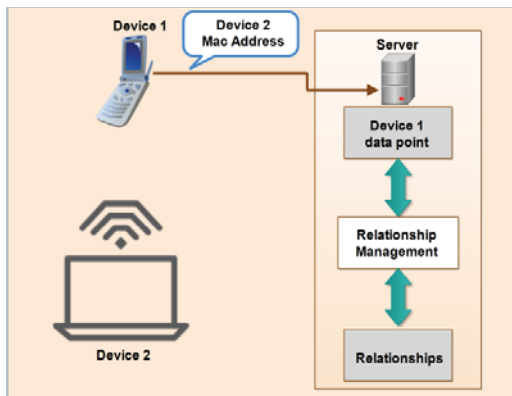


Figure 4. Device identification during meeting

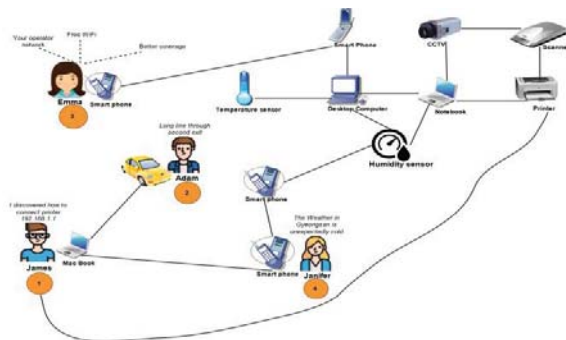


Figure 5. Sample application use case

IV. PROTOTYPE IMPLEMENTATION AND FUTURE WORK

In this section, we discuss a prototype implementation based on the earlier stated use case. Figure 6 illustrates the prototype implementation of the platform. The components of prototype constitute, social application server (SAS), Social application client (SAC) along with big data module, i.e. Hadoop is used to hold smart objects on it. The gateway is used to connect the object container. It includes home sensors, smart cars, PC and printer, etc. The application server module comprised of three major components: i.e. profiling relationship management (PRM), Dynamic relationship, service management function (SMF) and group management, etc. The SMF is an entry point for the discovery of requests; i.e. it interprets and evaluates the service request. In addition, it is also responsible for matching the service request with the available template. The SAC works as a client machine and therefore, it is responsible for registering client objects. In addition, the components of SAC comprised of object details such as; description, profile, and Adjacency Matrix, etc. Initially, a smart object along with details registered on the SAC. We have designed a web interface for the registration of smart objects to the client machine. In addition, we used Raspberry pi as a client. The description and the details of each object profile are listed in Table 1. The adjacency matrix handles various relationships for objects such as OOR, POR, SOR, and C-LOR, etc.

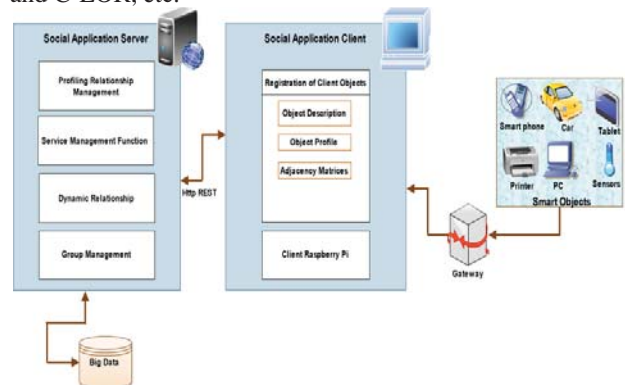


Figure 6. Prototype implementation components

A. SAS and SAC Communication

The process of sending or receiving the object data to the server is given as follows. Initially, each object, such as a laptop, writes its own API key (that key is known to that object). If the object wishes to retrieve the data of neighbors from a server, then it reads the API key of that object from which it wishes to receive the data. The read API key is recognized to the friends and the object. The read API key is necessary when the data retrieval is performed from a friend to a friend. The data from SAS server can be obtained by using one of the two following methods:

- Pull: - Every object requires data at regular intervals or when needed.
- Push: - Data are sent from the server to objects when available.

Since we are currently working on this prototype. Thus, in future, we have plan to present the achieved results and its efficiency.

TABLE I. A). OBJECT DECEPTIONS, B) OBJECT PROFILE

A)					B)		
Id_device	id_user	device_type	device_brand	device_model	device_type	id_off_service	Id_req_application

V. CONCLUSION

In recent years, objects connected to the internet are increasing on an hourly basis, this is why it provides a social structure to the IoT. Additionally, it ensures the navigability between the objects. Therefore, the SIoT is a popular research topic nowadays, because it guarantees the scalability of service provisioning features even in case of a trillion number of objects connected to each other. Our proposal is based on the making of social relationships among the objects, and it is very similar to human relationships. For this, we introduced a combined platform for IoT and SIoT. Our platform inherits the features of social networks such as service composition, relationship management, and recommendation, etc. we explained our proposed platform by using a use case and sample application scenario for the social network.

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