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A Review SIoT (Social Internet of Things): Techniques, Applications, Challenges and Trends

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Abstract

The social or human actions in the IoT platform derive the new paradigm in the IoT environment called the Social Internet of Things (SIoT). The Social Internet of Things is that part of an IoT capable of establishing social relationships with other objects concerning humans. SIoT attempts to moderate IoT challenges in scalability, trust, and resource discovery by taking a cue from social computing. In the IoT family, there is a subset of SIoT, a relatively recent concept. Moreover, a method of integrating IoT with social networking. SIoT is a simulation of human-to-human and object-to-object social networks where Humans are called intellectual and relational objects. They build their social network to accomplish shared objectives such as enhancing accessibility, success, and productivity and providing their needed services. This paper has extensively surveyed the SIoT (social Internet of things) for beginners involved in SIoT Studies. This paper gives you a clear view and ideas about SIoT's architecture, relationships, trust management, and applications and challenges implemented related to SIoT.

Keyword: IoT, SIoT, Social Networks, Relationship Management.

1. Introduction of IoT

The Internet of Things is a symbiosis of various technologies and changes drastically what can be achieved from the Internet. IoT works with various enabling and emerging technologies such as wireless sensor networks (WSNs), sensor technologies, machine learning and artificial intelligence (A.I.), big data, and analytics. At the heart of IoT are WSNs, consisting of sensors deployed in a sensing area to monitor specific phenomenons (such as environmental monitoring) and collect data. Furthermore, even more, pervasive network configurations are being developed where all possible devices (mostly of heterogeneous nature) connect to sense, gather and analyze data of different natures to act upon the intelligence gained from deep insights of the data. These actions are primarily without human interaction. The word IoT was first made famous by Kevin Ashton in 1999 when he implemented radio

frequency identification (RFID) for supply chain management applications. Since then, IoT has defined a paradigm of any possible devices or things connected to the Internet for data collection, knowledge formation, and automation. IoT has generated much attention from governments, industries, and researchers. According to a forecast from the U.S. National Intelligence Council (NIC) in 2008," by 2025, internet sensors may be implemented in everything such as plants, food packets, vehicles, furniture.". In the world population of 7.2 billion in 2015, there were 25 billion devices connected to the Internet, i.e., 3.47 connected devices per person. This number is expected to rise to 50 billion with 6.58 connected devices per person (with a world population of 7.8 billion). The communication in IoT applications usually constitutes the following connections, as seen in Fig. 1 (Farhan, L., Kharel, R., et al., 2018, July):

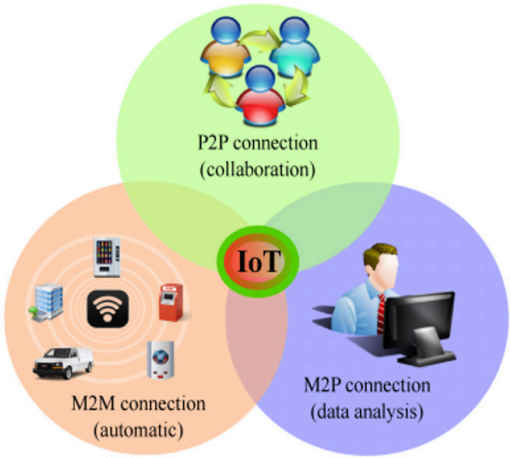

Fig. 1: Internet of Things (IoT) elements.

• People to People (P2P) connection: is the data transfer from one person to another. It occurs through video calls, telephone calls, and social communications. It is usually called a collaboration connection.

• Machine to People (M2P) connection: is the data transfer from machines such as computers, sensors, or others to users to analyze it. For example, weather forecasting uses intelligent devices to gather data from the environment and send it back to the administrators in the control center for further analysis.

• Machine to Machine (M2M) connection: is the data transfer between devices without human interactions. For instance, a car talking to another car about its speed, lane change, or braking intentions.

The communication of IoT networks combining three main categories based on their technology elements can be summarized into a simple relation as below:

IoT = Human + Physical Objects (sensors, controllers, actuators, devices, computing, storages) + Internet (Farhan, L., Kharel, R., et al., 2018, July).

1.1. IoT Communication Architecture

IoT is a complex infrastructure that includes sensing, clusters of data from numerous sources, and remote monitoring. The interaction of human-to-human or human-to-computer is not a necessity. The transmission covers four levels: device, edge, fog, and cloud, as shown in Fig.2. The device layer contains sensor nodes. Then sensed data is processed through edge and fog computing up to the cloud, where information is saved. The communication is often wireless as well as full duplex (Gunathilake, N. A., Al-Dubai, A., & Buchanan, W. J., 2022).

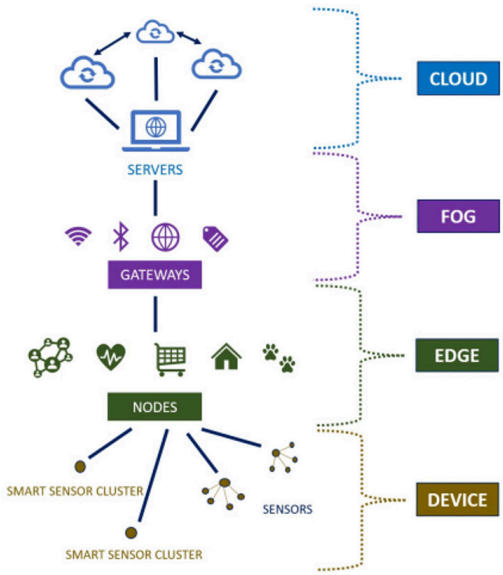

Fig. 2: IoT communication architecture (Gunathilake, N. A., Al-Dubai, A., & Buchanan, W. J., 2022).

This extensive area is subjected to different categories to offer optimized functionalities nationally and internationally. This state includes propagation technology development, privacy/safety challenges, standardization in common platforms to avoid translation overheads, and legal/regulation fixation for liability. The frequency spectrum is the unlicensed ISM (industrial-scientific medical) band. Depending on future possibilities, the licensed band may be utilized because the existing wired/wireless telecommunication infrastructure operated under the International Telecommunication Union (ITU) regulations also uses IoT benefits (Gunathilake, N. A., Al-Dubai, A., & Buchanan, W. J., 2022).

1.2. How the Internet of Things Works

The introduction of computer technology, the availability, volume, and speed of information processing are becoming decisive in developing the country's productive

forces, science, culture, social institutions, and all spheres of human activity. Information and big data today are seen as leading resources that must be appropriately organized and secure to be used efficiently and without fear for the safety of personal data. The main ideas of the modern scientific vector of information technology are based on the concept that all data must be organized in an information base to adequately reflect the changing natural world and meet users' information needs. The expression "Internet of Things" (Internet of Things or IoT) was first used by American researcher Kevin Ashton. Speaking to the management of Procter&Gamble, he talked about how the logistics within the company would change after the mass introduction of radio-frequency tags. However, only a few years have passed, and the Internet of Things has evolved from a business concept into an everyday reality accessible to everyone. In the late 2000s, the IPSO Alliance organization emerged. It aims to develop and implement solutions related to the Internet of Things.

In 2011, the research company Gartner included the IoT in the list of the most promising emerging technologies. Furthermore, in 2012, the whole world started talking about IoT. The concept of the modern Internet of Things lies in analyzing "things" connected to the Internet to exchange data with other things - applications, connected devices, industrial machines, and more. Devices connected to the Internet use embedded sensors to collect data and, in some cases, act on it. IoT-connected devices and machines can improve the way we work and live. Examples of applications of the Internet of Things range from a smart home that automatically adjusts heating and lighting to an intelligent factory that monitors industrial machines to look for problems and automatically adjusts to avoid failures. Let us note the specifics of how the system functions: Today, the Internet of Things is a ubiquitous communication infrastructure. Secondly, the global identification of each object. Thirdly, the ability of each object to send and receive data through a personal network or the Internet to which it is connected (Fig 3) (Kabarukhin, A.P., 2022).

1.3. IoT Layers

The architecture of IoT, a gateway of various hardware applications, is developed to establish a link and expand IoT services at every doorstep. Dif-ferent

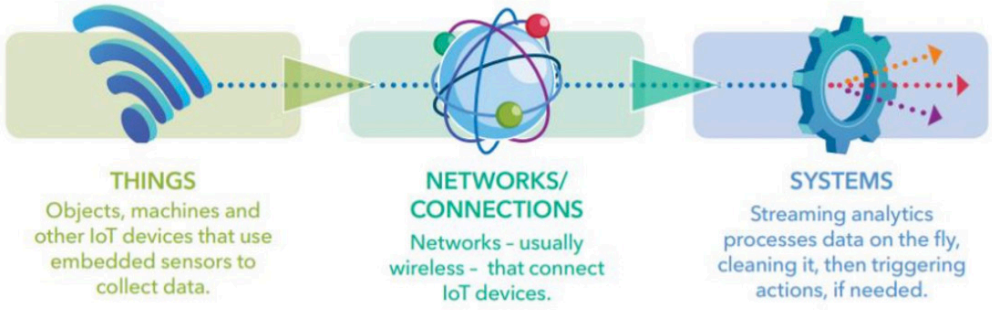

Fig.3: How the Internet of Things Works (Kabarukhin, A.P., 2022).

communication protocols, including Bluetooth, WiFi, RFID, narrow and wideband frequency, ZigBee, LPWAN, and IEEE 802.15.4, are adopted in different layers of IoT architecture to transmit and receive various information/data. Moreover, large-scale high-tech companies have IoT platforms to serve their valuable customers, such as Google Cloud, Samsung Artik Cloud, Microsoft Azure suite, and Amazon AWS IoT. A standard IoT architecture consists of three layers, i.e., perception/physical layer, network layer, and web/application layer, as shown in Fig 4.

Application Layer: The application layer is the third layer in IoT systems that provides users service through mobile and web-based software. Based on recent trends and usages of intelligent things, IoT has numerous applications in this technologically advanced world. Living space/homes/buildings, transportation, health, education, agriculture, business/trades, and energy distribution system. have become wise by the grace of the IoT system and its uncounted service (Tahsien, S. M., Karimipour, H., & Spachos, P., 2020).

Network Layer: The network layer is more critical in IoT systems because it acts as a transmission/redirecting medium for information and data using various connection proto- cols, including GSM, LTA, WiFi, 3-5G, IPv6, IEEE 802.15.4, which connect devices with intelligent services. Some local clouds and servers store and process the information in the network layer, which works as middleware between the network and the next layer. Big data is another critical factor in the network layer because it attracts the attention of today's ever-growing economic market. The physical objects from the physical layer continuously produce vast information/data transmitted, processed, and stored by IoT systems. Since information/data are essential for innovative services in the network layer, ML and Deep Learning (DL) are extensively used to analyze the stored information/data to utilize better analysis techniques and extract good uses for intelligent devices (Tahsien, S. M., Karimipour, H., & Spachos, P., 2020).

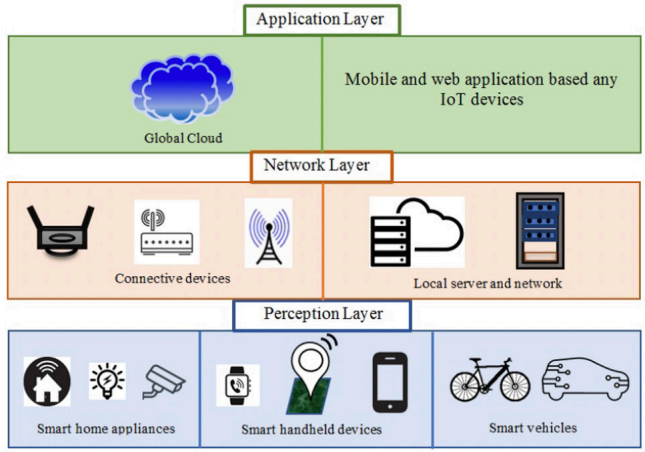

Fig.4: IoT layers architecture (Tahsien, S. M., Karimipour, H., & Spachos, P., 2020).

Perception Layer: The first layer of IoT architecture is the perception layer which consists of the physical (PHY) and medium access control (MAC) layers. The PHY layer mainly.

Deals with hardware, i.e., sensors and devices that transmit and receive information using different communication protocols, e.g., RFID, Zigbee, Bluetooth; the MAC layer establishes a link between physical devices and networks to allow for proper communication. MAC uses different protocols to link with network layers, such as LAN (IEEE 802.11ah), PAN (IEEE 802.15.4e, Z-Wave), and cellular network (LTE-M, EC-GSM). Most of the devices in IoT layers are plug-and-play types from where a massive portion of big data is produced (Tahsien, S. M., Karimipour, H., & Spachos, P., 2020).

2. Online Social Networks

In recent years, virtual social networks have gained widespread popularity among different groups of people, especially young people, and these networks have become a part of people's daily activities. This rapid development of information technologies necessitates increasing the absorption of social media in current scientific programs and other related matters. Social media consists of various web tools that enable users to distribute and share new ideas, thoughts, and information in an interactive and virtual environment. Some terms related to social media include social network communication, social networking sites, social networking tools, blogs, and web 2.0. These terms have been used interchangeably in the literature to describe the multifaceted space of the Internet in recent years (Sarwar, B., Zulfiqar, S., Aziz, S., & Ejaz Chandia, K., 2019). Some experts prefer to use the term social networks instead of social media due to the network function of this media category. However, social networks are a word used to name a group of people with wider and continuous communication among themselves and form a coherent circle of communication. However, today, this word is mainly used to name the internet sites where people can access the information of other members, learn about their interests, share text, audio, and video productions, and form groups. Based on common interests with some other members, they find the base. The main function of all virtual social networks is to provide a means of communication for their users to be in contact with friends and socialize with them through the Internet. Social networks are a new generation of internet websites based on web technology. These networks allow member users to create a personal profile, have a list of other users, and establish two-way communication with them (Khoshraftar, M., & Mohammadpour, S., 2017). Social networking service is an internet platform used to create and develop social relationships between people. This tool provides a platform for users to interact online with people who have similar interests, whether for romantic or social purposes. It allows users to share email, instant messaging, online comments, wikis, digital photos and videos, and post blog content. It also gives disabled people an opportunity to

present their thoughts and opinions in a virtual environment. Social networks have a dual role as providers and consumers of content, providing a choice to the user who can create their profile. To see. Some sites allow users to upload images, add multimedia content or change their appearance and profile, submit blogs, comment on posts, set up contact lists, and share. Social networks usually have controls that allow users to choose who can view their profile, protect user privacy, contact them, and add them to their contact list. himself to add or other (Sadiku, M. N., Ashaolu, T. J., & Musa, S. M., 2019).

2.1. Features of Online Social Networks

social network; Social networking sites are online platform that allows users to create a public profile and interact with other users, i.e., social networking allows people to (1) create a public or semi-public profile; (2) describe relationships between individuals (3) and review their list of connections. Nodes in social networks refer to people, and edges between nodes describe the relationships between people; in addition, S.N.s are characterized by the following characteristics (Sadiku, M. N., Ashaolu, T. J., & Musa, S. M., 2019):

- Community-oriented: Social network users want to find new friends and reconnect with old friends they have lost touch with.
- Interactive social networks: provides users with ample space to interact with events and news so that they can receive the latest news and react to it. User-based: Users update information on the social network in real-time.

3. Social IoT (SIoT)

People have started learning more about IoT's "social" part in the past few years. In the mid-1990s, the concept of the Internet was that of an ecommerce and information services network. However, then came YouTube and Facebook, and the concept of IoT was first introduced in 1999 when Aston Kevin from MIT coined the word "Internet of Things." In this way, the battle with IoT is trying to find a special publicity message about how it can enrich human lives. It has been argued that those linked to the social network provide substantially more accurate answers to complicated problems than a person alone. This thinking and suggestion is further seen as part of the late trend and redesigns the concept of IoT into SIoT. So, the SIoT is a "modern miracle moment for science"' Social networking sites, and it has drawn many researchers from a few regions (Shahab, S., Agarwal, P., Mufti, T., & Obaid, A. J., 2022).

Nowadays, S.N. and IoT are both among the most promising paradigms; merging these technologies lead to a wide range of intelligent services and applications to deal with the many challenges that individuals and organizations face in their daily lives by allowing people to be related to anyone, anywhere, at any time. While IoT studies have typically mentioned communication to the physical world by detecting or acting through many different devices as the most significant novelty. A new

paradigm called Social IoT (SIoT) refers to a set of embedded objects connected via the Internet through unique addressing schemes, considering humans related data such as profiles, preferences, and habits, i.e., Social IoT is used for context awareness through engaging users and users' profile to provide user-oriented services and recommendations. For this purpose, there are two considerations:

1. increasing sociality (or connectivity)
2. enhancing pervasiveness (or availability) (Bouazza, H., Zohra, L. F., & Said, B. (2019, December).

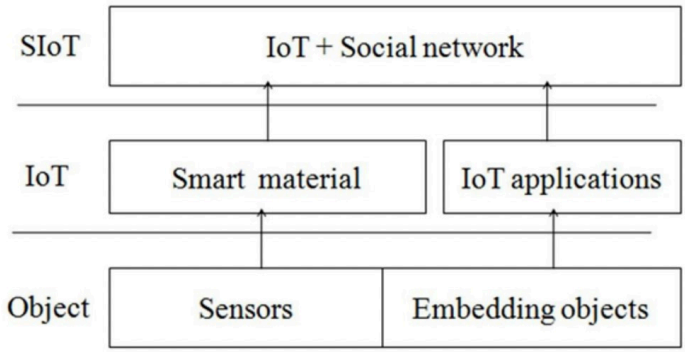

Fig.5: Combination of social network and IoT (Bouazza, H., Zohra, L. F., & Said, B. (2019, December).

It is defined by the "Social Internet of Things (SIoT)" as an Internet of Things where things are suitable for building solid relationships with various objects, regardless of people. Therefore, an unofficial and structured way of connecting networks to transmit and receive information in a system and company. The ' Thing ' in SIoT is related to one another and social. In brief, using the idea of the "Social Internet of Things SIoT "as a "new time of miracle for technology" can easily turn a thing "into a smart and interactive" thing to create a very cooperative and commutative system. Facebook, Snapchat, LinkedIn, and Pinterest., for instance, have drawn significant numbers of scholars from several areas. This social interaction between human things and objects is a process now developed as SIoT (Pati, S. P., & Gupta, B., 2020).

The SIoT incorporates IoT and social media, where each entity may separately create relationships with other entities in response to the algorithms provided by the holder's entity. The components of SIoT are shown below in Fig 6. The physical environment includes many artifacts of the actual world incorporated in the technologies of detecting, actuating, transmission and communication. These objects are essential components of an IoT implementation and give a kind of service that people or other items used to carry out their daily routines. There may be social networks between such elements at different levels and of varying levels. Individuals form societies between themselves based on many factors like shared goals, desires,

and relationships while still being connected to the physical thing by connections like use and possession. Physical objects often create interdependencies based on characteristic attributes such as level of communication and position (Jara, A. J., Bocchi, Y., & Genoud, D., 2014, September). The SIoT is designed to handle billions of items when dealing with the exploration of knowledge and operation and is not designed for IoT detection and connectivity. Moreover, primarily through the exploration and structure of services, it seeks to establish independent communication between entities to profit the customer (Pati, S. P., & Gupta, B., 2020).

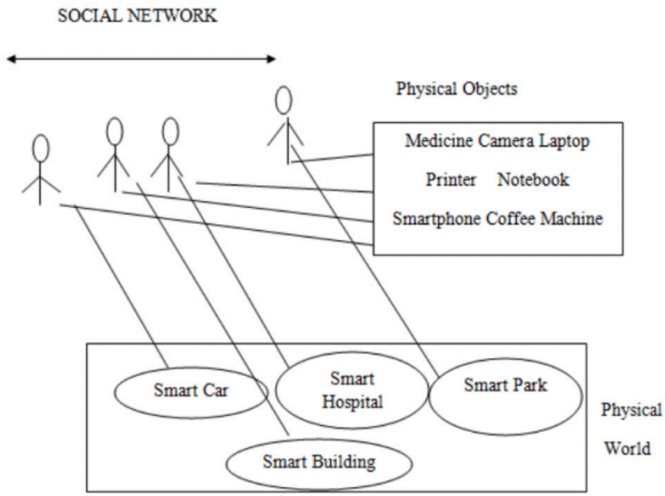

Fig.6: Illustrates components of the social Internet of Things (Pati, S. P., & Gupta, B., 2020).

Since the idea that the convergence of the "Internet of Things'' and the worlds of "Social Networks'' is feasible early, energy is accumulating. This state is because of the growing awareness that an ideal outcome of the "Social Internet of Things." The SIoT would express various appealing consequences, rinsing everyone's normal lifestyle (Pati, S. P., & Gupta, B., 2020). Benefits social Internet of Things (Berman, F., & Cerf, V. G., 2017):

- The SIoT framework can be configured as necessary to ensure the system's user-friendliness. The exploration of entities and resources is easily carried out, and the scalability is assured, as in people's social media.
- A degree of truthfulness can be developed to leverage communication between friends.
- Prototypes intended to study social networks could be recreated to deal with issues linked to the Internet of Things (intrinsically linked to comprehensive networks of interlinked objects).
- Stability is assured, as is the case with people; a degree of reliability can be

made to use the level of communication between objects that are partners or mates.

• Structures built for social media could be used to resolve the difficulties and matters related to the Internet of Things.

3.1. Evolution of SIoT

As we know, the future of ubiquitous computing is set in motion in a wide range of intelligent services and applications that address the many challenges that individuals and organizations face in their everyday lives by enabling people and things to be connected to anyone or anything, and anywhere, at any time. With 'social networks, ' worlds are conceivable, and power is growing. Currently, it is the first notion of the creation of SIoT derived from 2000, SIoT mimics the nature of human social networks and explains how to connect and select friendships or choose a friend of a friend (FoAF) amongst various items to help and deliver a variety of high-quality services (Atzori, L., Iera, A., Morabito, G., & Nitti, M., 2012). Then (Atzori, L., Iera, A., & Morabito, G., 2011) became the first to bring forth the idea of social interaction between the devices of the IoT system (Holmquist, L. E., Mattern, et al., 2001). Fig. 7 Describes the Evolution of SIoT from the Pre-Internet (human-to-human communication) (Shahab, S., Agarwal, P., Mufti, T., & Obaid, A. J., 2022).

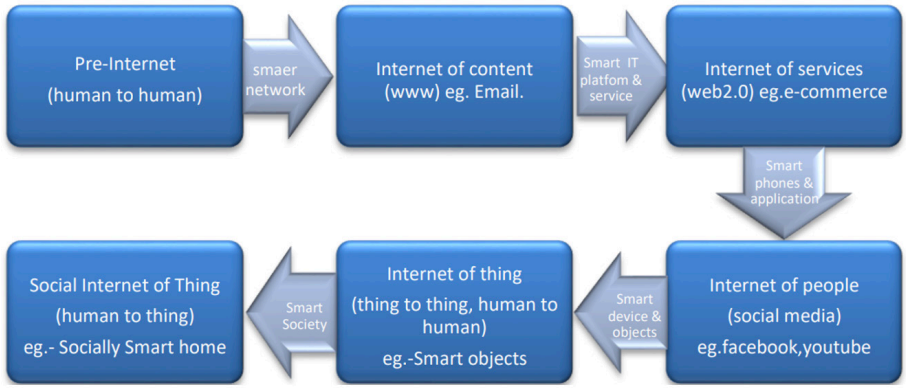

Fig. 7: Evolution of SIoT (Shahab, S., Agarwal, P., Mufti, T., & Obaid, A. J., 2022).

3.2. Architecture of SIoT

While there is no uniform architecture for SIoT, most publications suggested a three-tier architecture that includes. The base/object layer includes a database for storing data and handling a database on ontologies, semantic engines, and communications. Next, the middle/ composite layer takes care of interactions like an object-to object, social-to-social, or object-to-social interactions in the pervasive setting. It also supports tools for the primary and satellite components (Malekshahi Rad, M., Rahmani, A. M., Sahafi, A., & Nasih Qader, N., 2020). Then the upper/ application layer ensures user engagement with SIoT applications. The multimedia

tools conduct all consumer applications and interactions like audio, text, Service Programming Interfaces, Social Relationship Models, and Social Presence. Finally, the Human is dedicated to communicating between different instances with SIoT servers to update their profile and the partnership between friends to discover/ request services on the social network (Shahab, S., Agarwal, P., Mufti, T., & Obaid, A. J., 2022). The variety of IoT applications has led to numerous IoT structure models. Consider a three-layer structure: Perception layer, Network layer Application layer.

The perception layer, additionally called the recognition layer, is the lowest layer of the traditional structure of SIoT. This layer is chargeable for processing information from "things" or the environment (like WiFi Sensor Networks, heterogeneous devices, sensors, and many others). A few different models consist of one extra layer: an assisting layer between the application layer and the network layer. For example, the ITU-T (International Telecommunications Union—Telecommunication Standardization sector) indicates a layered SIoT structure composed of four layers. The SIoT application layer containing the utility person interface is the top layer. The offerings and application aid layer is the second layer from the top. The third layer is the network layer which includes networking and transport abilities. The lowest layer is the device layer, which incorporates gateways, sensors, RFID tags, and many others. The safety abilities, categorized into regular and particular, are distributed alongside all four layers. The three fundamental factors of the proposed system are the SIoT server, the gateway, and the Objects (Mawgoud, A. A., Taha, M. H. N., & Khalifa, N. E. M., 2020).

• The SIoT system contains a server, gateway, and object, and these components are distributed to three main layers: Sensing, Network, and Application.

• SIoT server: the server is situated in the application layer and encompasses three sub-layers; the Base layer is The Handling data layer which consists of the database for storing and managing data with their descriptors, ontology databases, semantic engines, and communications. The Resource management Sub-layer comprises tools that implement the SIoT system's key functionality, such as I.D. management, profiling, and relationships management. The Interfaces sub-layer is devoted to ensuring the best way of communication between objects, humans, and services.

The object: the sub-layers, which the objects consist of, may mainly vary depending on their nature; we have two kinds of objects; dummy objects (sensors) and smart objects (smartphones). In a simple scenario, the dummy object's role is sending the sensing data to another equipment (gateway); in this case, the object encompasses just the lowest layer, the sensing layer. Otherwise, the bright object may contain the three sub-layers, Sensing, Network, and Application. This latter encompasses the SIoT application, the social agent, and the service management agent, presented in Fig 8.

The social agent is dedicated to communicating with SIoT servers to update

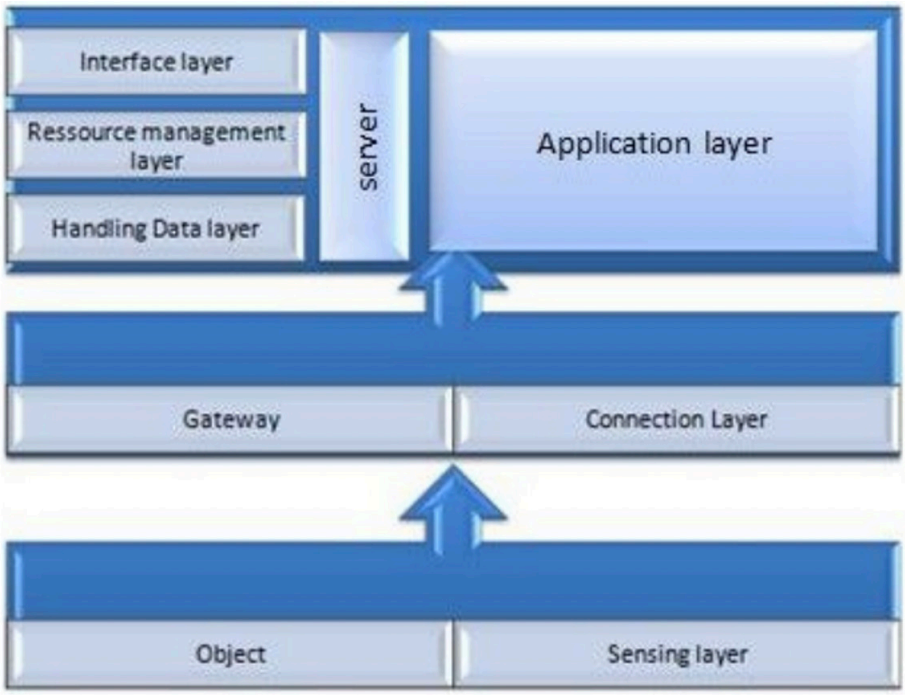

Fig.8: Architecture for the SIoT ecosystem (Farhan, L., Kharel, R., et al., 2018, July).

profiles and friendships and discover and request social network services. It is also implemented to allow objects to communicate with each other when they are close geographically. The Service management agent is responsible for interfacing with humans that can control the object behavior of the object when communicating within their social network. The gateway is made up only of the Network layer to ensure the connection between.

3.3. SIoT Servers and Objects

Relationships management: Things on the Social IoT can mimic human being behavior on Social Networks, in addition to the analysis of possible service and application typologies built on the envisaged Social Internet of Things. Authors in (Tahsien, S. M., Karimipour, H., & Spachos, P., 2020) propose the following classifications of the defined relationships:

Parental object relationship (POR) means established among objects produced by the same production batch, that is to say, generally homogeneous objects from the same manufacturer and in the same period. Furthermore, objects can establish a Colocation object relationship(C-LOR); this type of relationship is defined among objects (either homogeneous or heterogeneous) worked continually in the same place (as in the case of sensors and actuators).

On the other side, augmented things used in the same environment such as a smart home or a smart city) this relationships can also be established sporadically between vehicles and intelligent objects when they meet in the same space. Another side also, the objects can mimic the relationships between workmates in a Co-work object relationship (C-WOR); this latter is established whenever the objects cooperate to produce a common IoT application (as in the case of objects coming into contact to be used together and cooperate for applications such as emergency response, telemedicine. Heterogeneous objects, which belong to the same owner (mobile phones, music players, game consoles.), can establish a relationship named Ownership object relationship (OOR). The last relationship defined in (Guinard, D., 2011) is the Social object relationship (SOR) which is established when objects come into contact, sporadically or continuously, because their owners come in touch with each other during their lives (e.g., devices and sensors belonging to friends, classmates, travel companions, colleagues).

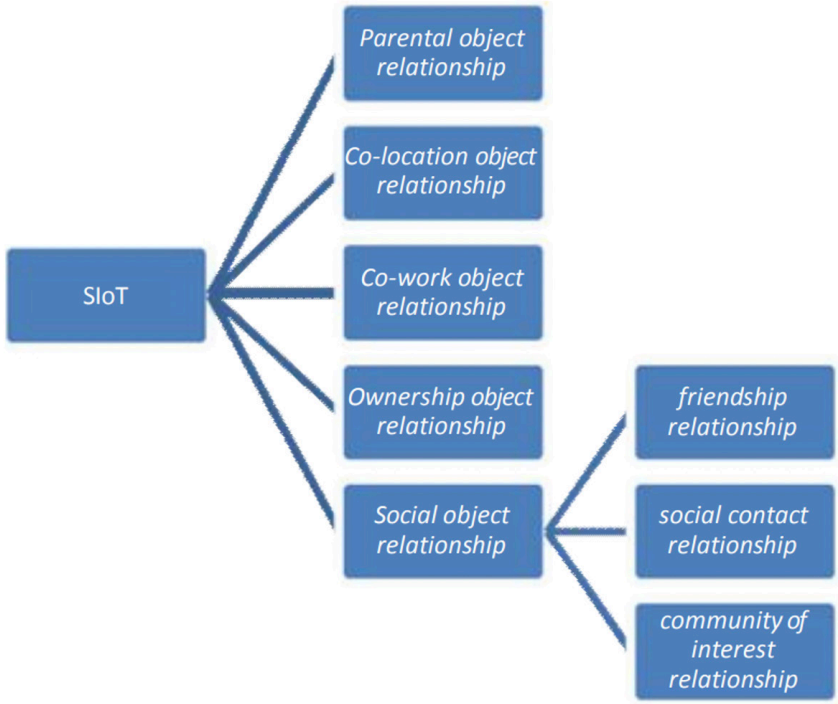

Fig.9: Type of relationships between the object on SIoT

Scalability: SIoT structure can be shaped as necessary to ensure the seamlessly of the network. Hence, scalability is guaranteed as on a human social network. Further, every node is capable of creating social relationships with other things.

Service discovery: based on the scalable system, each object can look for the

requisite service by exploiting the information about its relationships to guarantee an efficient search for the desired services and objects in the same way humans find for knowledge in S.N.

Trustworthiness: fulfilling trust management consists of collecting the required information to make a trust relationship decision, evaluating the criteria for choosing the trust relationship, verifying and readdressing the existing relationships, Moreover ensure the dynamic change of trust relationships. A level of reliability can be established to take advantage of the degree of interaction between things that are friends (Bouazza, H., Zohra, L. F., & Said, B. (2019, December).

3.2.1. SIoT Server

The SIoT server does not encompass the sensing layer, however only the network and the application Layers. The Application Layer includes three sublayers. The base Sublayer consists of the database storing and controlling the data and the applicable descriptors. These document the social member profiles and their relationships, in addition to the activities accomplished through the objects in the actual and virtual worlds. Data about humans (object owners and visitors) are also controlled. The relevant ontologies are stored in a separate database and are used to symbolize a semantic view of social activities. Such a view is extracted through suitable semantic engines. Certainly, ontology and semantic services are essential to provide a machine-interpretable framework for representing practical and non-practical attributes and operations of the SIoT devices. Several works have already been performed in this context, which can be a starting point for defining an ontology for use within the SIoT system (Mawgoud, A. A., Taha, M. H. N., & Khalifa, N. E. M., 2020).

3.2.2. Gateway and Objects

As to the Gateway and object systems, the mixture of layers may vary depending on the device characteristics. The following three situations can be foreseen. In a simple one, a dummy object (e.g., an RFID tag or a presence sensing device) which is geared up with a capability of the lowest layer, is enabled to send signals to another gateway. The gateway is prepared with the entire set of functionalities of the three layers. In another scenario, a device (e.g., a digital camera) can sense the physical global data and send the associated data over an I.P. network. The object could then be set with the capability of the network Layer aside from that of the application one. Consequently, there is no need for a Gateway with application Layer capability. An application Layer in a server, somewhere inside the Internet, with the gateway application layer capability, could be enough (Mawgoud, A. A., Taha, M. H. N., & Khalifa, N. E. M., 2020).

3.4. Challenges SIoT

There are some problems facing the SIoT system that lower the output level. Other

requirements must be accompanied to enhance their functionality and relevance throughout various SIoT framework environments. Some of the preconditions and obstacles to implementing a robust and reliable SIoT program are as follows (Pati, S. P., & Gupta, B., 2020).

- Scalability: The discovery system has to control the massive number of SIoT connected entities.
- Mobility: The exploration framework has to manage entities that often switch their place.
- Dynamicity: Evolution structure deals with connection to the Internet and abandoning the network, resulting in a shift in the system's topology.
- Opportunistic Existence: Discovery framework can manage objects with the SIoT network's active connection status.
- Heterogeneity: Exploration programs can take into account a broad range of entities, several methods of interaction, and a range of programs.
- Interoperability: Discovery framework work at various levels and frameworks between diverse information sources.
- Adaptability: The exploration method's security procedures must adapt to new climatic conditions.
- Survivability: Trust protection procedures for the discovery method must withstand targeted attacks.
- Resiliency: The exploration system should be robust to threats and set up a safe means of communication.
- Standardization: Discovery programs with commonly accepted conventional communication protocols must be enforced.

3.5. Applications SIoT

Some of the applications listed below are from the literature survey (Kumaran, P., & Sridhar, R., 2020, June).

- Monitoring the environment
- Administering industrial plants
- Managing cities and homes
- Maximizing engagement with social Gamification
- Easing remote monitoring
- Chasing and tracing (rental bicycles and fleets)
- Controlling facilities (elevators and energy)
- Operating the vending machines segment
- Offering metering(utility meters)
- Overseeing healthcare systems
- Running smart homes
- Providing automation and context detection
- High heterogeneity of resources and capabilities.

- Uncertain nature of the trustworthiness of single objects.
- I am handling virtualization platforms, naming services, and migration.
- They coordinate techniques in a cooperative mechanism where instances, social entities, locations, and data are communicated coherently.
- I am managing context acquisition.
- They are influencing the ability of heterogeneous objects and services from different manufacturers.

Conclusion

Social networks are prevalent in today's world. Millions of people use various forms of social networks as they allow individuals to connect with friends and family and share private information. However, issues related to maintaining the privacy and security of a user's information can occur, especially when the user's uploaded content is multimedia, such as photos, videos, and audio. Uploaded multimedia content carries information that can be transmitted virally and almost instantaneously within a social networking site and beyond. This article is an overview of the combination of social networks and the Internet of Things, which results in the Social Internet of Things. The Internet of things (IoT) is considered to revolutionize how the Internet works and bring together the concepts such as machine-to-machine (M2M) communication, big data, and artificial intelligence. To work under the same umbrella such that cyberspace and human (physical systems) are more intertwined and thus ubiquitous, giving rise to cyber-physical systems. Nowadays, IoT has gained significant attention from researchers since it has become an important technology that promises an intelligent human being life by allowing communication between objects, machines, and everything together with people. IoT represents a system consisting of things in the real world and sensors attached to or combined with these things, connected to the Internet via wired and wireless network structures. This article is an overview of the social Internet of Things. The "Social Internet of Things (SIoT)" has been the focus of numerous independent development initiatives as it ensures distributed infrastructure with billions of distributed entities and facilitates impressive new technologies. Although the SIoT has performed a few scientific studies, the rate of increase is remarkably high, making it a global analysis phenomenon. Some SIoT applications, like the cloud, are used for processing and concurrent service delivery due to restricted consumer smartphone assets. In reality, SIoT is a new revolution in its development, which tries to solve the problems of optimization, efficiency, and the exploration of information and support by empowering people's social media and providing opportunities for improved communication between people and objects. In this article, the review of the Internet of Things and social networks was discussed. The central part discusses the primary and essential concepts of the Internet of Social Things, architecture, components, layers, and types of relationships between objects on SIoT.

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