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## PREVENT THE TRANSMISSION OF USELESS / REPEATED DATA TRANSMISSION IN THE INTERNET OF THINGS NETWORK


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**ABSTRACT**

Internet of Things (IoT) is a new and advanced network technology that incorporates inter-object communication and sensor technology that connects almost every controllable electronic device to be used in daily life with a different Internet Protocol (IP) address in a network environment. In a such large-scale network, data transmission, process monitoring, data processing and network traffic are also required to be addressed. Today's Internet architecture uses the TCP / IP protocol stack for communication and is insufficient to meet the needs of the large-scale IoT network. Therefore, it will be a big advantage to reduce the data traffic in an IoT network where large amounts of data will be generated. In this study, a new method for reducing the data traffic in a designed IoT network is proposed and the data traffic on the network is reduced by preventing the transfer of useless / repetitive data in the network environment. A four layered (sensing layer, internet/network layer, transport layer and application layer) IoT architecture has been proposed by Çavdar and Öztürk in 2018. In the sensing layer, it is aimed to prevent unnecessary and repeated data from being transferred in the network environment by analyzing and eliminating the data. In addition, preventing the transmission of unnecessary and repetitive data to the network environment will bring many advantages such as storage, data traffic speed and storage cost.



***Keywords:*** *Internet of Things, Big Data, Sensor Technology, Data Transmission*

## 1. INTRODUCTION

The Internet has begun to be used to share limited data packets in the 1980s, and there has been an increase in the number of devices connected to the internet Quentin Stafford-Fraser, Paul Jardetzky and their colleagues connected a camera to the coffee machine shown in Figure 1 to observe the amount of coffee in the coffee machine in the unit named Trojan Room in Cambridge University and transfer it to a common network, pulling the pictures of the coffee machine at certain time intervals, e.g. a snapshot every 30 seconds. This developed system is regarded as the Internet application of the first objects (Stafford-Fraser, 2001).

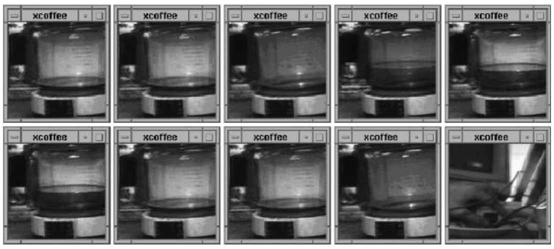


Fig. 1. Trojan Room coffee machine

In later years, an idea was born that each object could be numbered with a different IP number and actively used in the internet environment. Followingly, a toaster machine was invented by John Romkey in early 1990s, which can be opened and closed over the internet (Romkey, 2017). IoT, which has taken its place in everyday life as a practical application on a very small scale, was conceptually used in 1999 by Kevin Ashton in a presentation for a company.

Along with the developing technological infrastructure, a large number of different objects that can be connected to smart devices, mobile phones and internet environment have been produced and continues to be produced. In IoT, the concept of an object is defined as any device that can be connected to the internet and send / receive data (Çavdar and Öztürk, 2018). Companies such as Intel, IBM, and Cisco, which have a large share of information technology in the marketplace, are also continuing to develop various products under IoT (Bozdoğan, 2015). Innovation and progress in the field of information and communication technologies, which have become a part of our developing and everyday life, keeps up evolving, especially in the last thirty years.

As the use of the Internet began to spread, the sharing of information was accelerated, and the technical progresses have taken a long way. Electricity, which is regarded as the greatest invention of the 19th century, nowadays has left its place to the internet and information technologies. Especially, in the past quarter century we have made great progress in science through the developments in the information technologies. In other word, the world has taken its path in science and technology for centuries in the past quarter century (Öztürk *et al.*, 2017). In the years when information technology and the internet are actively used, development rate differs by one to seven when compared to the years when information technology is not available. More developments are observed than in the seven years that they have never been used in information technology and the active use of the internet (Stafford-Fraser, 2001).

There are many definitions in the literature for IoT. For example; A. Al-Fuqaha and others have preferred the following definition for IoT: The physical objects of IoT are the systems that control or organize viewing, perception, thinking, decision-making, data sharing and communication with each other (Al-Fuqaha *et al*., 2015). The International Communication Union (ITU)'s definition as follow "Any time any object / device can be connected to any technology." (ITU, 2012). Çavdar and Oztürk have formulated in a different manner; "It is the whole of the global systems that allow objects (smart mobile devices, televisions, cars, etc.) to be addressed and used anytime and anywhere." (Çavdar and Öztürk, 2018).

## 2. SUGGESTED METHOD

As in all disciplines, a specific road map is created at first step for any project and depending on this road map the work is started. This is similar in Information Technologies (IT). In the IT era, the structure (that can be considered as a road map) and a set of rules constitute the reference model. For this reason, when an application or a project is developed in IOT, with a reference architectural model the system efficiency will be increased and total cost will be reduced.

With the increasing number of things connected to the IoT network, the protocols and architectures that are used today are inadequate and will have difficulties for future needs. There are tens of proposed architectural models existing in the literature due to the lack of a well-defined architectural model. In order to solve this problem, a new four-layered (sensing, internet/network, transport and application layers) architectural model has been proposed by Çavdar and Öztürk, which addressed as a reference architectural model for IoT. It has been thought that it could be useful to select and eliminate the repetitive / useless data in the sensing layer of this proposed model. In the data analysis phase, the detection and the elimination of the redundant data reduce the storage costs. It will also be a good step in terms of minimizing the transaction complexity.

In Figure 2, the 4-layered IoT architectural model proposed by Çavdar and Öztürk in 2018 (Çavdar and Öztürk, 2018), unlike the architectural models in the literature, the data evaluation phase is performed at the detection layer, which can be characterized as physical layer. The transmission of this data in the network environment only for emergency cases will help both in processing large data and avoiding data garbage. The data collected from the sensors should be analyzed to prevent the data from being continuously sent to the network environment if there is no abnormal situation. Thus, data transmission rate can be reduced, the rules defined by the users can be accommodated and the further data transmission can also take place in emergency cases. In addition, if a request is made directly by the client or by the application layer for remote control and inspection, the decision sublayer sends the required data to the upper layer and does not require a separate emergency signal to be transmitted in the network environment.

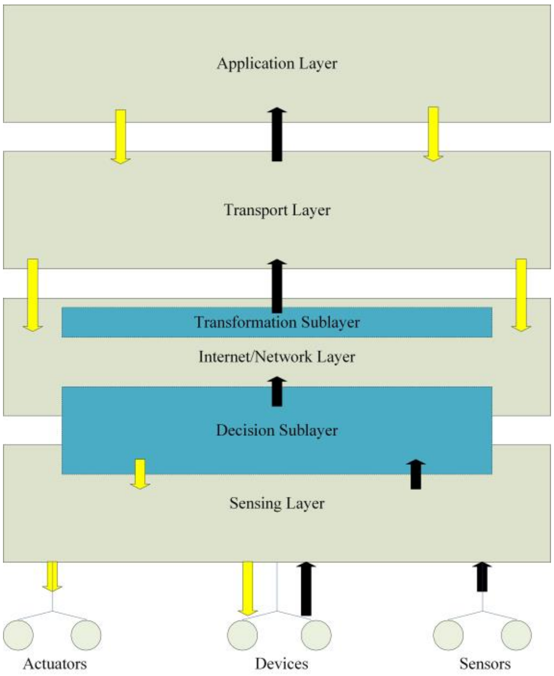


Fig. 2. 4 layered IoT architectural model proposed by Çavdar and Öztürk. (Çavdar and Öztürk, 2018)

In Fig. 3, the flow chart of the data detection, evaluation and routing stages of the decision sublayer are shown. The data coming from the detectors are first compared entirely with the help of the rules defined for the decision sublayer.

The mentioned rules are contained in a modem and central unit are reachable through an interface where the sensors and actuators are connected. The comparisons are performed in this interface, through which the comparison result is sent to the upper layer if it is necessary for different objects and applications, or if the data is requested by the client. Otherwise, the operation is continued by the running connection with the agents and the unnecessary data is terminated. The rules in the decision-making layer, which is the underlying framework to which the sensors are attached for physical conditions such as heat, temperature, humidity, smoke, vibration, etc., bear the conditions that must be under daily and normal conditions. In the simulations, those conditions are chosen as the values closer to normal values. But, in real applications, meteorological data can be sampled in advance and compared with the perceived data during the day to perform more realistic evaluations.

Thus, the system will become more useful and more efficient, and the delays to be experienced due to differences in the sensing and data transmission capacities of detection technologies will be partially overcome (Öztürk, 2018).

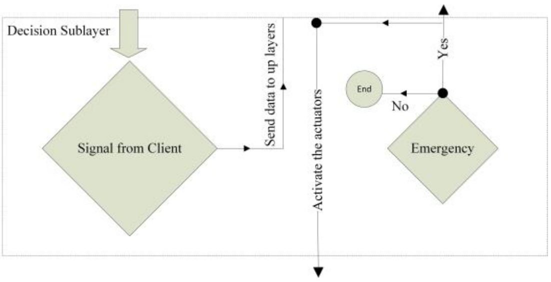


Fig. 3. The internal structure and functioning of the decision sublayer

In the decision sublayer, at the time of unit data transmission the number of data packets (network traffic in an IoT network) can be mathematically formulated as follows in case of a normal network condition:

$$\text{Total Number Of Packages} = \sum \frac{[(\boldsymbol{S}+\boldsymbol{N})*\boldsymbol{P}]}{\boldsymbol{T}} \quad (1)$$

In a network where the proposed model is used, the number of packets at the time of data transmission in unit time;

$$\text{Total Number Of Packages} = \sum \frac{[((\boldsymbol{S}-\boldsymbol{G})+\boldsymbol{N})*\boldsymbol{P}]}{\boldsymbol{T}} \quad (2)$$

S: Number of sensors
N: Number of complex things (PCs, Phones, etc.)
P: Average number of incoming packets
T: Time
G: Data forwarded to actuator without being transmitted to the network environment.

As given in the equations (1) and (2), the increase in the number of sensors leads to an increase in unnecessary data in the network environment. With the help of the proposed method, this data can be eliminated, and the network environment can be used more efficiently. It is more probable that data traffic will diminish considerably when a large number of sensors is considered. Also, mathematically expressed, The decision sublayer and the defined functionalities for large scale IoT networks including large data sets associated with the detection phase and the evaluation process of the traditional and innovative techniques hosted by IoT increase the efficiency of the system. (Öztürk, 2018).

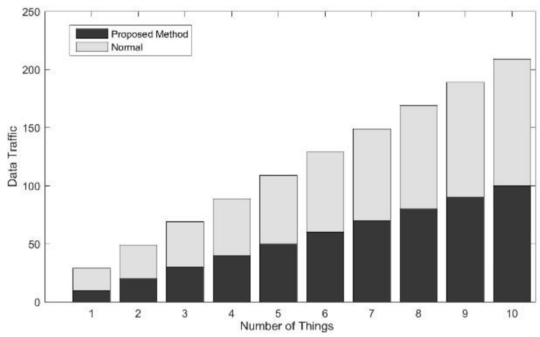


Fig. 4. Comparison of the network data densities in the normal and proposed method.

In accordance with the simulations conducted in Matlab environment, Fig. 4 shows the data density of the network, in which a normal network architecture and the proposed architecture are used. Accordingly, a significant reduction in the number of packets opened on the internet and the number of packets opened on the network and in the data traffic on the network was observed before the Internet (taken from the sensors) from the objects / devices and from some of the data received from the sensors. Here, the reduction in the number of data packets does not cause any packet loss. On the contrary, the data packets excluding the emergency signals coming from the sensors are routed to the actuators.

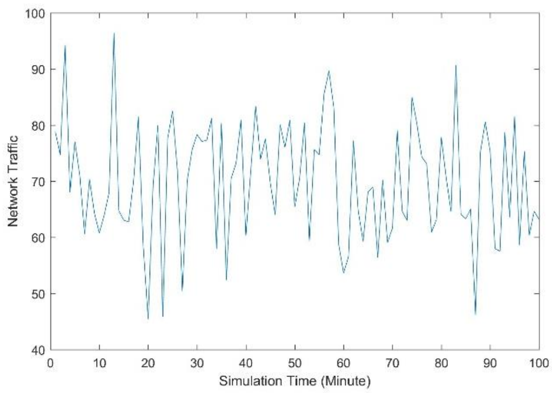


Fig. 5. Observation of network data traffic.

The data is transmitted to the internet environment after analyzing the data coming from the client and the detectors in the decision sublayer. The other remaining packets are forwarded to the agents without being transferred to the internet environment and the expected action is performed at that moment. According to the simulation results depicted in Fig. 5, the data traffic in the network decreases over time through the employment of the proposed method.

## 3. CONCLUSION

In this study, general information about IoT is given at first. Then, with respect to the detection layer of the previously proposed architectural model, data analysis and elimination of repetitive / useless data are explained and the results are examined. Since there are no simulation studies about the subject, comparison of the proposed method with any other technique could not be performed.

Through this work a new method has been developed to point out the importance of the usage of proposed paradigm, to meet the needs of different applications, to provide meaningful information transfer and to make resources quick and easy to use, since the IoT envisages a world in which billions of devices connect and communicate with each other through wired and wireless networks. Also, from a technical point of view, in a heterogeneous system, extensibility among objects, scalability, functionality, reliability, privacy/security and interoperability are all dependent on the data traffic of the network. In conclusion, this study provides general information about IoT and proposes a new method to reduce data traffic by preventing redundant data communication and transfer of useless data to the network environment in multi object links. The proposed method is explained theoretically, the data flowchart is given , the developed technique is evaluated throughout various simulations, the results are examined and interpreted.

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