

## **Automatic data access and automatic exchanges in a heterogeneous Ecosystem**

**Phadatare Manasi Mahadeo, Dr. T. V. Gopal, Raj Bahadur Singh**

Ph.D Research Scholar: SRM Institute of Science & Technology (SRMIST), SRM University Chennai India.

Dean – CET, Kattankulathur SRM Institute of Science & Technology (SRMIST), SRM University Chennai India.

Co-Guide: Prof.(Dr.) Ashoka Institute of Technology and Management, Varanasi, Uttar Pradesh 221007

### **Abstract:**

The Internet of Things (IoT) is widely seen as the technological revolution of the future, bringing billions of devices and items online. There are many different kinds of these connected devices. Different protocols are used by different technologies and standards to communicate with one another. These problems with heterogeneity make it difficult to deploy IoT on a large scale. This gave us the idea to determine the issues raised in the literature and provide solutions to address the IoT scalability conundrum. This study's foundation is the methodical assessment of the literature to pinpoint the various issues and potential fixes. A total of 81 primary sources were selected. After extracting and synthesizing the data, we identified 14 different IoT heterogeneity issues. Several challenges have been identified, including "Heterogeneity of devices," "Heterogeneity in data formats," "Heterogeneity in communication," and "Interoperability Issue Due to Heterogeneity". The aforementioned challenges have been investigated from the perspectives of digital libraries and timelines. Furthermore, we have found 81 solutions in total for those issues, with at least 5 distinct solutions found for each difficulty. We will rate the solutions and classify the issues using a multi-criteria decision-making problem in the future.

**Keywords:** Automatic, data, access, automatic, exchanges, heterogeneous, Ecosystem

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## **1. Introduction**

### **Motivation**

The Internet of Things (IoT) is the extension of present Internet services to offer connectivity to every item in this planet. The Internet of Things has emerged as the most popular technology worldwide. Everyone is attempting to understand this new technology, which is still in the research stage, in accordance with their individual demands. Security, virtualization, and heterogeneity are three major obstacles to the deployment and interpretation of IoT. The multidimensional problem of heterogeneity prevents the widespread use of IoT vision. Due to

these difficulties, IoT system implementations have only partially materialized up to this point. This inspired us to conduct a thorough literature analysis in order to pinpoint the problems caused by IoT heterogeneity and their remedies. This study's deep investigation of such difficulties utilizing the chi-square test based on digital libraries and period is another addition.

## 2. Introduction

IoT is regarded as a significant improvement among the fad technologies in today's technological age. Devices that can connect to Internet sources are the simplest way to describe the Internet of Things (IoT) [1]. These gadgets have been expanding steadily in recent years. By 2030, there will be around 500 billion gadgets linked to the Internet, according to reference [2]. These IoT gadgets will continue to link with other devices in a significant number, both physically and virtually, creating new opportunities for engagement.

This will make it possible for us to link all of the items in our surroundings in every region of the globe at once. These items might be sensors, cellphones, and autos, robots used in industry, thermostats, refrigerators, tablets, and more. Both academics and industry have embraced the IoT. It is creating commercial possibilities across a wide range of industrial markets in both the public and private sectors. In the near future, the Internet of Things will host billions of heterogeneous devices thanks to the IoT industrial revolution.

## 3. Research Methodology

To identify the heterogeneity issues in IoT systems that are impeding a comprehensive IoT vision and to discover solutions, a systematic literature review (SLR) technique is used.

Table 1 : Research questions.

| No. | Research questions   |
|-----|--|
| RQ1 | What are the challenges in heterogeneous IoT in the literature?                    |
| RQ2 | What are the solutions to these challenges in heterogeneous IoT in the literature? |

### Search String

The search for pertinent papers on the study subject is the second step in a systematic literature review. Digital libraries such as IEEE Xplore, Springer Link, Google Scholar, Science Direct, and

ACM were recognized as the key search engines. Then we established a list of terms associated with our study area, including "Internet of Things," "IoT," "heterogeneity," "heterogeneous," and "challenges." Finally, search terms were created and employed to gather published publications pertinent to the study's subject. Table 2 lists the search terms available.

**Table 2**  
**Search strings.**

| Sources        | Search string   | Context       |
|----------------|---|---------------|
| Google Scholar | ( "Heterogeneous Internet of Things" ) AND ( "issues OR challenges" )         |               |
| IEEE Explore   | "Heterogeneous" AND ( "IoT" OR "Internet of Things" ) AND "challenges"        | IoT           |
| Science Direct | ( "IoT" OR "Internet of Things" ) AND ( "heterogenous" ) AND ( "challenges" ) | heterogeneity |
| ACM            | ( "IoT" ) AND ( "heterogenous" ) AND ( "challenges" )                         |               |
| Springer Link  | ( "IoT" ) AND ( "heterogeneity" ) AND ( "challenges" )                        |               |

### Study Selection

The research selection process is to perform search in digital libraries based on the tollgate approach considering the search strings. Figure 1 shows a selection of articles using the tollgate approach.

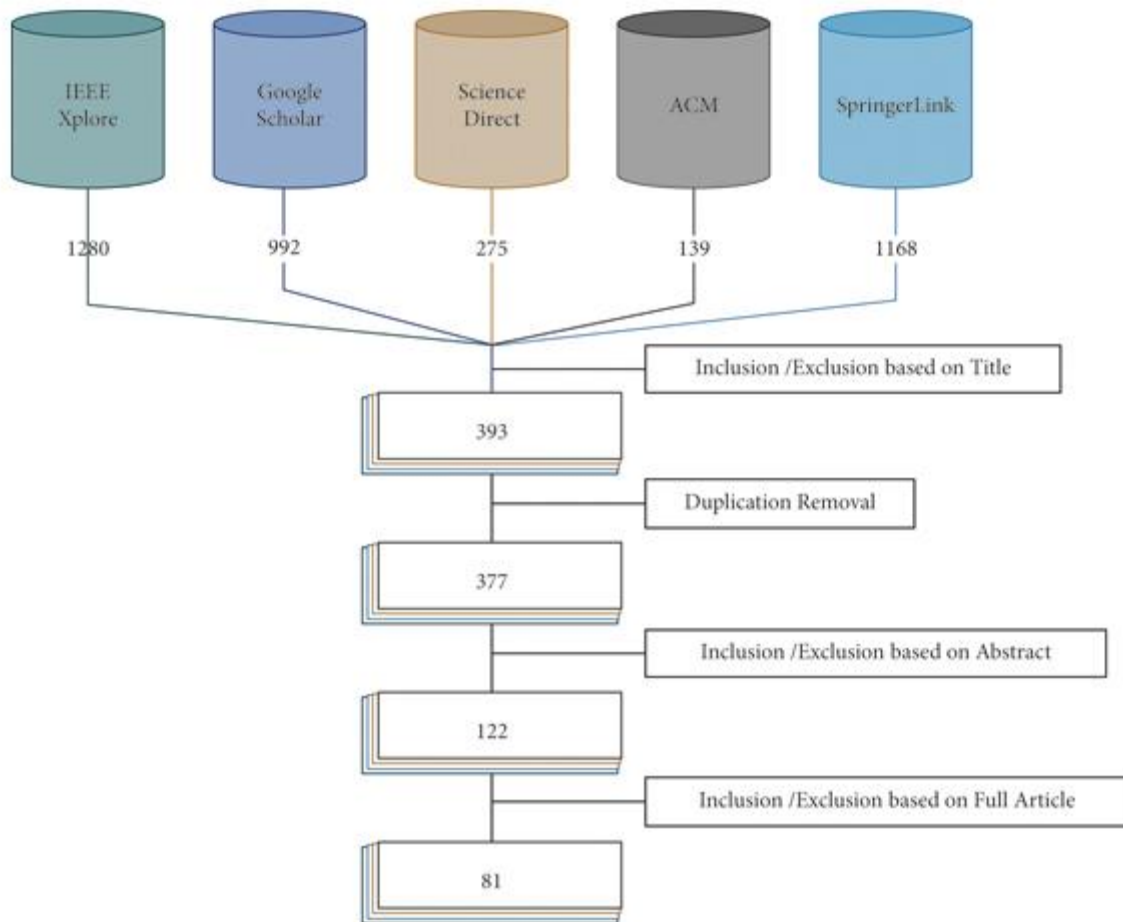


Figure 1 :Selection of articles using the tollgate approach.

In the snowballing process, we chose nine papers from conferences (SIGCOMM, MobiCom, MobiSys, and INFOCOM) and journals (IEEE TMC, TPDS, JSAC, ToN, TWC) whose content is examined and discussed in Section. 3854 publications were first chosen by using a search methodology on the chosen digital libraries. A selection procedure has been used that takes into account the keywords, titles, removal of duplicate content, abstracts, and full texts of the chosen articles. We did not include the following sorts of papers:(1) Research papers that have appeared in publications besides conferences, journals, patents, and technical reports(2)Research articles published in languages other than English (3)Studies from before 2010 (4)Studies unrelated to the specified search strings

We evaluated the following components to gauge the research articles' quality:(1) The study offers details on any IoT heterogeneity problem (2) The study clearly addresses the highlighted

heterogeneity difficulty (3) The study was published from a reliable and reputable publication source

#### 4. Conclusion and Future Work

This study does a thorough evaluation of the literature in the field of IoT heterogeneity. A methodical approach was used to implement the review and choose several papers that addressed the difficulties encountered by heterogeneous IoT. A total of 81 research articles published between 2011 and 2021 in various digital libraries were chosen for this investigation. We split this period of time into two periods for examination. One spans the years 2011 through 2016 and the other, 2017 through 2021. To adopt IoT on a broad scale, we have found 14 key heterogeneity concerns in this SLR that need to be solved.

The most serious challenges are those having an incidence percentage of greater than 30%. In this study, we examine the incidence of such problems based on both temporal and digital libraries. Through this investigation, we discovered that some problems were more pressing in the past than they were now.

We also learned that some difficulties persist in both periods. These difficulties were recognized, and we came up with at least five remedies for each one. Table 6 provides a summary of those solutions. In our upcoming study, we intend to use a multi-criteria decision-making issue to classify the problems and rank the answers.

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