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Systematic Mapping Study on RFID Technology

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Abstract: The technique known as radio frequency identification (RFID) allows for the real-time monitoring of objects at every stage of a mobile object network and the reporting of information on their present condition in addition to serving as an object identifier. One of the most promising research fields nowadays is RFID, which is getting more and more attention. There is a tonne of literature in the field of RFID as a result of this interest. But because the research was carried out from various angles, there is now a growing body of knowledge that is dispersed across numerous fields. We conducted a systematic mapping study (SMS) to fill this gap. The SMS is based on a well-established research methodology from the scientific communities of medicine and software engineering, and it aims to analyse and identify the approaches used, the quantity and quality of publications, the types of research, and publication trends that have shaped the field of RFID research over the past 20 years. Its findings were based on 219 studies that were carefully chosen from 4294 studies found in the digital libraries of IEEE Xplore, Scopus, and Web of Science and categorised by research type, research area, citation type, and application domain. In order to determine future research paths in the RFID field, we analysed and synthesised the findings of this SMS. This SMS's first in breadth offers a reliable, thorough, and reproducible description of contemporary RFID technology; The results could have repercussions for professionals like researchers, journal editors, reviewers, and universities that want to comprehend and use RFID.

Keywords: RFID

I. INTRODUCTION

In many fields, including supply chain management (SCM), medicine, transportation, and Internet of Things (IoT) applications, RFID, or radio frequency identification, is used to identify objects or people who have been fitted with RFID tags. RFID is a type of automatic identification and data capture (AIDC). The extremely persistent research operations, especially with a view to providing new technological solutions, indicate the fact that technology is in full expansion.

For instance, chipless RFID is not equipped with any electrical circuitry to manage communication protocols because its primary mode of operation relies on resonance from metallic surfaces. Therefore, a wide range of other applications for this RFID innovation may exist. Despite the fact that RFID technology is widely used, studies constantly reveal that people are unaware of it, are unsure of what it is, what it can do, and what its limitations are. This is mainly because there isn't a thorough classification scheme for RFID.

Based on the aforementioned justifications, the primary goal of this work is to undertake a systematic mapping study (SMS) to outline the current state of the art in the field of RFID and to serve as a foundation for subsequent research in the area. A good overview of a study topic is provided as well as reusable research abilities by participating in an SMS. Additionally, such a study offers a methodical and impartial procedure for determining the type and amount of empirical study data that are available to address a specific research question. In order to achieve this, the primary research question aims to identify and examine how studies on RFID technology have changed over the past 20 years, as well as what approaches, types of study, trends, publications' amount and calibre, and gaps there have been in this area. In order to efficiently gather all the pertinent studies, a methodology outlined in the following existing principles was implemented. This approach was based on a clearly defined protocol. 4294 publications were initially found by a thorough search technique using the IEEE Xplore, Scopus, and Web of Science databases. 219 of them were chosen, and each was assigned a classification based on the research type aspect, research area facet, citation facet, and

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applicationdomain facet using a particular classification scheme. The findings for each classification process parameter were then analysed and discussed.

II. METHODOLOGY

Radio Frequency Identification, or RFID, is the abbreviation. More specifically, it is a radio frequency identification system that employs RFID tags to identifyitems as they pass past a scanner. Unlike a barcode, we are able to memorise and retrieve their data in addition to following their course. Without a direct line of sight, this technology enables communication between objects andreaders.

A. THE BASIC ELEMENTS OF AN RFIDSYSTEM

No matter the frequency, an RFID system must include the following components: RFID tags, RFID readers, and a software interface known as "middleware." RFID chipsand antennae are among the components that go into making tags and readers.

RFID TAGS

An electronic identification support is the RFID tag. An antenna for receiving waves and an electrical circuit for storing information make up its two major components most frequently. They can be thrown away or reused.There are actually three categories of tags: Thereare three sorts of tags: passive tags, which only take energy from the reader, active tags, which include batteries that enable them to send signals, and semi- passive tags, which function similarly to passive tags butmay also store various forms of data.

The existence of a battery and the lack of an integrated transmitter are the two main distinctions between semi- passive RFID and active and passive RFID.Despite the many benefits of RFID technology, its adoption is still constrained by a number of technological, economic, and societal issues. One of these issues is the high cost of tags, which is caused by the requirement for RFID chips.A growing amount of research has been conducted in recent years with the goal of creating a new technology dubbed RFID chipless technology. For communication with the reader with this technology, the tag has a planarencoder and sporadically an antenna.

RFID READER

The RFID reader, which reads information from RFID tags, is the electromagnetic version of an optical barcode scanner.It is a piece of technology that can be either stationary or mobile and is essentially made up of an antenna and an RF module.

RFID MIDDLEWARE

Middleware, whether it be software or hardware, is typically a collection of software layers that serve as an interface between several applications. For RFID projects, the middleware will make sure that there is asmooth interface between the information system thatwill be using the data that has been collected and stored in the memory of RFID tags.

B. OPERATING PRINCIPLE OF RFID TECHNOLOGY.

Electromagnetism-based energy transfers are the foundation of RFID technology. The RFID reader transmits radio frequencies that cause neighbouring RFID chips to become active. The reader emits electromagnetic energy to the tag as soon as it is in theintegration zone, enabling the tag to function andconvey data. The reader transmits the data directly to the middleware for processing after receiving it back from the chip in the tag.

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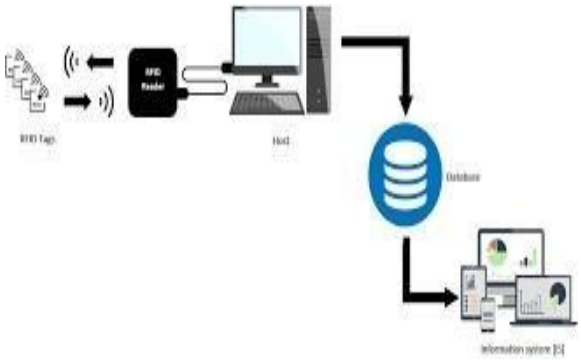

Fig 1.Basic system components.

III. DISCUSSION

In this section, the main conclusions of this systematic mapping investigation are provided along with the findings of a quantitative analysis. Examining current RFID research is the paper'sprimary goal.

PUBLICATION CHANNEL

It offers details on the evolution of the RFID research field. These SMS findings show that journal papers (83/219, or 38%) and conference proceedings (110/219, or 50%) account for the majority of RFID research publications, respectively. This can be explained by the innovative nature of conferences, which also serve as quicker dissemination channels for research findings and a catalyst for information sharing between academics and industry professionals. Only 3% (7/219) of the initial found publica are represented. Although this type of publication, tions was a book that came out in 2005, books are intended to present or provide an in-depth subject overview. Chapter book publications continue to have a lower rate, with 9% (19/219).

PUBLICATION TREND

The publications between 2000 and 2020 were categorised in the current work. Since 2006, RFIDpapers have drawn an increasing amount of interest. As can be seen, 2007 had the highestproductivity. With the exception of 2019–2020, the number of articles rose overall from 2006 to 2018.As a result, 50% of the publications were publishedbetween 2000 and 2012, while 50% were publishedduring the other eight years.

It makes sense that there weren't any publications between 2000 and 2003 given how new RFID technology was at the time. The fact that research on RFID technology has been continuously touched by new technical innovations may help to explain the increase of publications.The quantity ofpublications in RFID may have changed as a resultof changes in the general literature; there has been a shift from print to electronic versions of papers, which has greatly increased the accessibility ofresearch materials, particularly open-access publications.

COUNTRY WITH THE HIGHESTAMOUNT OF RESEARCH RFID FIELDS

The majority of the research that werechosen were carried out in the United States, China, and other English-speaking industrialised nations likeAustralia, Canada, and the United Kingdom. Fundingfor R&D may be the main cause of this. For instance, the US spent more than any other nation in 2017 on research and development. However, since 2000, China's R&D spending has increased while its global share has decreased.Spending on R&D was $2.107 trillion worldwide in 2018. The US continued to provide more R&D funding than any other nation. China was in second place.

APPLICATION DOMAINS

With contributions to many areas, RFID is an interdisciplinary field. The results show that "SCM and Logistics" (with 19%) is the primary application domain of the chosen studies. This finding can be explained by the adoption movement of Radio Frequency Identification (RFID) technology, which started in the United States in two industries, retail and national defence, in 2004. By 2005, Walmart and the US Department of Defence (US DoD) had made it a requirement

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for its vendors to use the technology.According to Figure 6, as a result of the potential opportunities that RFID technology may provide, it has expanded into new fields as a result of technological advancement and the emergence of new application areas. These emerging industries include Industry 4.0, sensing applications, pharmaceutical and healthcare, IoT, and complex environments.

RESEARCH TYPE

A significant rate of exploratory research and reviews compared to other study fields has been generated by the multidisciplinary nature of RFID technology and its multiple subfields. The results show that the researchers' top priority is to clarify issues related to RFID. The high proportion of synthesis papers (103/219), philosophical papers (24/219), and opinionpapers (11/219) all attest to this.

The goal of these three study kinds is to discuss,clarify, or provide a theoretical basis for RFID theories. With a number of publications of the solution proposal type (47/219), the results also reveal interest in advancing new strategies or expanding existingtechniques, and thus amplifies the potential for the incorporation and application of RFID technology in anumber of new fields.

As this type of research focuses on evaluating prior research efforts by implementing a solution inpractise, in order to provide practical explanations andto indicate advantages and drawbacks, it also reflects that the researchers do not go as far as the implementation phase of their solutions in real test scenarios (11/219).Indicating that the suggested methodologies are not supported by experiences is thefact that over three-quarters of the found publications do not fall under the category of evaluation study. Thefindings of this mapping study thus demonstrate that most writers suggest procedures, which are not, as a result, empirically validated. These findings imply that future research should concentrate on studies that support the approaches examined in order to capture the researchers' perceptions.

APPLICATIONS AND ADVANTAGES

- Determining research needs.
- Mapping the language of research.
- Identifying trends and patterns.
- Informing practise and policy.
- Laying the ground work for upcoming studies.
- Automated Data Collection.
- Enhanced Efficiency.
- Improved Accuracy
- Flexibility
- Security.

IV. CONCLUSION

To our knowledge, this is the only systematic mapping study that has covered RFID technology from a broad perspective as of the time of this writing. In order to categorise and summarise the state-of-the-art, as well as to list the challenges to be addressed by the software engineering research community in future works, the research presentedin this work has provided a breadth-first review of the research relating to the field of RFID technology. It has also provided an excellent platform for further research and investigation in the RFID field. From an initial set of 4294 articles from the IEEE Xplore, Scopus, and Web of Sciencedigital libraries published over the previous two decades, this SMS evaluates 219 primary studies. According to the parameters for the systematicmapping study, these studies were divided into four primary groups: research field, research kind, application domain, and citation. As it discusses research gaps and upcoming challenges, thissystematic mapping study is meant to serve as a baseline and reference for researchers to conduct more in-depth systematic reviews and follow-up studies examining the use of RFID technology.

It can be said that there is a significant and ongoing increase in RFID research activities across the globe, particularly in China, the United States, and other English-speaking developed nations like Australia, Canada, and the United

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Kingdom. We came to the conclusion that there is an increasing need for RFID technology in new application areas, such as "IoT applications," "Complex Environments," and "Industry 4.0," in addition to the SCM sector.

V. FUTURE SCOPE

To provide more thorough information on the various RFID middleware architectures (implemented or proposed), our research team anticipates finishing a survey on them. This survey's goal is to identify data management techniques that have been effectively used in RFID systems and provide a foundation for our future work, which aims to develop a new RFID middleware architecture.

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