ADVANCECRT

Centre for Research Training

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Latency Reduction in IoT Architecture: *A Systematic Mapping*

Research Motivation

- 60% of IoT projects fail at the proof-of-concept stage. Failures can be attributed to enterprises' reliance on the centralized cloud for data transfers which is synonymous with high latency and cost of data transfer.
- Current IoT architectures may have difficulty coping with the latency demands of next-generation IoT.
- The large volume of data generated by IoT devices leads to high data traffic, delays in transmission, and congestion.
- Difficulty in determining which data to store, its reliability, data security, computation, and analysis dept essentially to obtain valuable insights from the large volume of data.
- Poor user experience as a result of high latency

Interesting IoT Predictions

- Companies will Invest Up to $1.1 Trillion in IoT by 2023
- 50 billion IoT devices will be connected online by 2030
- Two-thirds of the world's population will live in cities by 2050

Use Cases

Remote Surgeries

Traffic management

Connected Cars

Cloud gaming

SYSTEMATIC MAPPING

Step 01

Definition of Research Question

The systematic mapping was guided by the research questions. Research scope was limited to IoT applications that have leveraged cutting edge technologies such as AI and 5G.

Step 02

Conduct Search

To determine the right keywords for the defined scope, we adopted the Population, Intervention, Comparison, and Outcomes (PICO) framework.

Step 03

Screening of Papers

Exclusion and inclusion measures were used to ensure studies that were relevant to the research questions get returned using the appropriate search phrases.

Step 04

Keywords in Abstract

Keywords were extracted from the research questions, and then a search through abstracts of the returned papers in step 3. This helped to identify context and to determine the right classification scheme.

Step 05

Data Abstraction and Mapping Process

A catalogue of published state of the art papers was read and put in different categories based on the research questions.

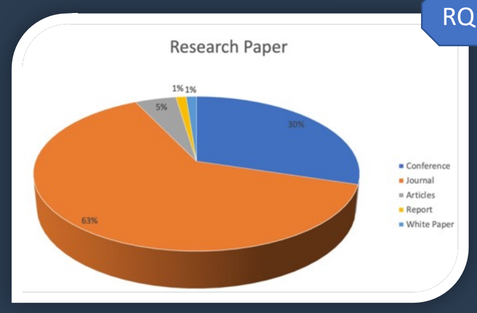
Research Questions

RQ1- RQ4

1. Which type of papers has the most research on latency reduction in IoT, and what year(s) were they published?
2. What are the most investigated IoT architectures that have leveraged emerging technologies such as AI and 5G in reducing latency for IoT Applications?
3. What is the most frequently used research approach in the investigation, and in what study context?
4. What are the future research directions and open perspectives of latency reduction in IoT applications?

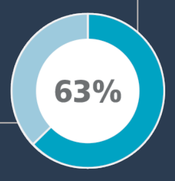
Research Answers to Guide Future Research Methods and Topics to Focus On.

RQ1

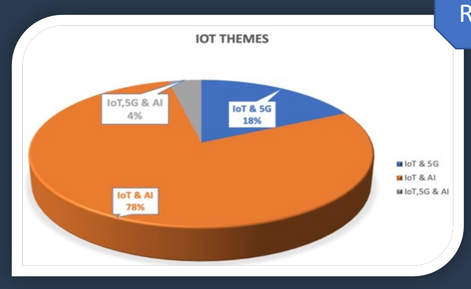


Academic journals lead with 63% publications while conference and report papers had the least publications of 1% each. Most of the journals were published in 2019.

Academic Journals

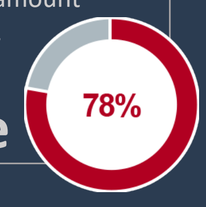


RQ2



AI had 78%, accounting for the highest agent used to reduce latency in IoT, followed by 5G with 18%, and the convergence of AI and 5G had the least amount of 4% out of a total of 28 papers researched.

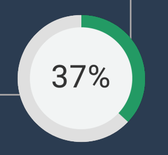
Artificial Intelligence



RQ3

A total of 84 papers were accepted out of the initial 5,846 obtained from an automated search result in five different databases. Solution proposal had 37% of the total selected publication followed closely by evaluation approach accounting for 33%.

Solution Proposal



Gaps and Opportunities

- There is a need to investigate the Transport, Network, and Perception layers, particularly related to data communication.
- The processing layer was second on the rank of problem areas as it relates to computation.
- Some problems identified include determining the right time and where to offload data, decision errors, breakdown in communications due to lack of data aggregation
- Academic Journals will be a rich source of information to get papers relating to latency reduction in IoT using AI and 5G, particularly papers published from 2019.
- AI had 78% of papers that used emerging technologies in reducing latency, accounting for the highest agent.
- The most research approach used was the solution proposal accounting for 37% of all six different approaches used.
- Opinion and philosophical methods had the smallest research approach used. In future research, expert judgment and opinion may be considered especially when **reliability** is one of the parameters for investigation.
- There was only one research that focused on the application layer with an opportunity to research data analysis and intelligence.
- There is a huge research gap combining AI and 5G in reducing latency.

RQ4

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Host Institution
UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh
MTU Ollscoil Teicneolaíochta na Mumhan Munster Technological University
Maynooth University National University of Ireland Maynooth
TU DUBLIN Ollscoil Teicneolaíochta Bhaile Átha Cliath Technological University Dublin

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