



Internet of Thing for Smart Campus: Systematic Literature Review

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Abstract: This research shows that IoT and Smart Campus are issues that will remain hot to be discussed even in the next few years, such as sustainable universities, big data, and the internet of things. The sustainable university variable is also a variable that is still rarely found and is a contemporary thing that can be studied by researchers. This is because not all campuses in Indonesia are able to implement this thoroughly. This can also be proven by the lack of research related to the implementation of smart campuses or smart universities in Indonesia. Then, the results of data processing showed that there were several technologies mentioned in the journal, which was the source of this research. These technologies are Beacon, Geofence, and Zigbee. These three are technologies that are often implemented and are considered important in implementing Smart Campus.

Keyword: IoT, Smart Campus, Technology, SLR.

1. INTRODUCTION

We often hear the word "smart" in everyday language to describe the intelligence, ability of someone or something. Currently, the concept of smart is not only focused on one object but extends to larger and more complex things such as smart homes, smart cities, smart campuses, and others [1].

Smart Campus refers to the integration of integrated campus life supported by technology [2]. The implementation of a smart campus is a development from conventional management to a campus that applies technology, although its implementation is not easy because it involves many facilities that must be realized [3]. Various researchers who build smart campuses provide definitions of smart campuses based on different approaches. If grouped, there are 3 approaches, namely: technology-based, adopting the smart city concept, and based on organizational business processes. Based on this, it can be concluded that the current state of smart campus development consists of smart campus features, smart campus technology, and smart campus applications [1]. The main goal of a smart campus is to facilitate all activities of the academic community [4].

applications [1]. The main goal of a smart campus is to facilitate all activities of the academic community [4].

With the continued development of the smart campus concept, it is very possible to implement smart technology such as Internet of Things or IoT-based [5]. With so many smart campus developments being built based on IoT, it is necessary to study what IoT technology can be implemented, has been researched, and is interesting to research through a systematic literature review process.

2. METHOD

The research method that will be used in this research uses the method proposed by Moher D et al[6], namely Systematic Literature Review (SLR). An overview of the methodology used can be seen in Figure 1.

1. Identification

At this stage, identification of the most representative keywords is carried out to be forwarded to the article search process. At this stage you can use various search media such as Google Scholar or via applications such as Publish or Perish.

2. Screening

At this stage, scientific articles are selected based on certain criteria, resulting in a number of scientific articles that will be used for the SLR method.

3. Eligibility

At this stage, a check is carried out on the suitability of the content with the title of the scientific article, whether it is related to the topic being discussed or not. At this stage, the number of existing scientific articles is still based on predetermined keywords, titles and abstracts.

4. Included

At this stage, checks are carried out on the suitability of existing scientific articles, the suitability of keywords, titles and relevant content so as to produce scientific articles that are more supportive of the research being carried out.



Fig. 1. Research Method

3. RESULT

This research uses a systematic literature review method. The processes carried out in this research where the search for the required papers comes from electronic databases obtained using Vos Viewer and Publish or Perish software.

3.1 SLR Process

The process of searching for scientific articles using the Publish or Perish 7 software by canceling the citation and patent checklists. The author uses the keywords "IoT Smart Campus" and "IoT Smart University". The keyword "IoT Smart Campus" produced 2541 articles and the keyword "IoT Smart University" produced 2428 articles, so there were 4969 articles obtained.

The screening process is carried out to find articles that suit the writer's needs, including topics, keywords, titles and article content. The author also ensures that there is no duplication in collecting the articles. There are several additional criteria, including: (1) Scientific articles written in the last 5 years; (2) The name of the publication is the journal; (3) Ranked in the top 100 of Publish or Perish search results, both with the keywords IoT Smart Campus and IoT Smart University.

At the eligibility stage, the author re-examined the 200 journal ranking results obtained from the previous stage. The selection of paper is based on the suitability of the title, abstract and keywords. There were 91 articles deemed suitable for the author's needs to proceed to the next stage.

At the included stage, a suitability check is carried out between the title, abstract and contents of the paper. At this stage, 46 papers were selected.

3.2 Discussion

Table I shows the papers selected for research using the SLR method.

TABLE I. SELECTED PAPER

No	Penulis	Judul Artikel	Tahun
1	[7]	Research on WLAN scenario optimisation policy based on IoT smart campus	2023
2	[8]	Future educational environment – Identification of smart campus topic trends using text mining	2023
3	[9]	Analysis of the development of sustainable entrepreneurship practices through knowledge and smart innovative based education system	2023
4	[10]	Construction of Smart Campus in Higher Vocational Colleges based on the Era of "Internet+"	2023
5	[11]	A determination of the smartness level of university campuses: the Smart Availability Scale (SAS)	2023
6	[12]	IoT-based Smart Campus Monitoring Based on an Improved Chimp Optimization-Based Deep Belief Neural Network	2023
7	[13]	Smart Campus Network Public Opinion Security Governance Strategy Based on Big Data	2023
8	[14]	Smart Campus Vocational College with Digital Twin for Sustainable Comfort Monitoring	2023
9	[15]	Internet of Things and Big Data for a Sustainable Smart University	2023

10	[16]	Bibliographic and Text Analysis of Research on Implementation of the Internet of Things to Support Education	2023
11	[17]	Internet of Things and Its Applications to Smart Campus: A Systematic Literature Review	2022
12	[18]	Smart Learning based on Moodle E-learning Platform and Digital Skills for University Students	2022
13	[19]	Selection of Internet of things (IOT) applications in education industry using the Best-Worst Multi-Criteria Decision-Making Method	2022
14	[20]	A Systematic Review of the IoT in Smart University: Model and Contribution	2022
15	[21]	Application of Internet of Things Technology in Mobile Education of Smart Campus Culture and Etiquette	2022
16	[22]	IoT-based model for intelligent innovation practice system in higher education institutions	2022
17	[23]	Revitalizing a Traditional Campus: Implementation of IoT-Enabled Smart Universities	2021
18	[24]	Design and Implementation of Smart Classroom Based on Internet of Things and Cloud Computing	2021
19	[25]	Usage of Internet of Things (Iot) Technology in the Higher Education Sector	2021
20	[26]	Research on the Application of DevOps in the Smart Campus of Colleges and Universities	2021
21	[27]	Design of Smart Campus using Zigbee based on USN	2021
22	[28]	A Review on Smart Campus Concept and Application towards Enhancing Campus Users' Learning Experiences	2021
23	[29]	Smart University: A University In the Technological Age	2021
24	[30]	I-Campus: Towards The Information Integration For Uitm Cawangan Melaka Implementation Of Smart Campus	2021
25	[31]	Design of smart campus management system based on internet of things technology	2021
26	[32]	A V-Model Software Development Application for Sustainable and Smart Campus Analytics Domain	2021
27	[33]	Personalized Smart Learning Recommendation System for Arabic Users in Smart Campus	2021
28	[34]	Research on the Application of 5G in Smart Campuses of Universities	2021
29	[35]	Mobile Green E-Waste Management Systems using IoT for Smart Campus	2021
30	[36]	Garbage Bin Monitoring System Based on the	2021

		Internet of Things at University Dirgantara Marsekal Suryadarma	
31	[37]	Past, present, and future of smart learning: a topic-based bibliometric analysis	2021
32	[38]	IoT text analytics in smart education and beyond	2021
33	[39]	A Cost Effective Campus Automation System Using BOLT-IOT	2020
34	[40]	A Design of Smart IoT-Based College Room Using Arduino	2020
35	[41]	Research on the Construction Strategy of Smart Campus Infrastructure in Vocational Colleges in the Age of 5G	2020
36	[42]	Researches on the Construction of the Smart Campus System with respect to the Higher Vocational Colleges in the Information Age-Taking Dalian Vocational and Technical College as an Example	2020
37	[43]	A Proposal of POLIMAS Smart Digital Campus with Internet of Things (IoT)	2020
38	[44]	Go Green Technology For Smart Campus With Iot (Internet Of Things) And Student Monitoring System-Palarch's	2020
39	[45]	Towards a smart campus for qassim university: An investigation of indoor navigation system	2020
40	[46]	A survey: The role of the internet of things in the development of education	2020
41	[47]	Toward a Smart Campus Based on Smart Technologies and Best Practices	2020
42	[48]	Building virtual 3D city model for smart cities applications: A case study on campus area of the university of novi sad	2020
43	[49]	Experiences With IoT and AI in a Smart Campus for Optimizing Classroom Usage	2019
44	[50]	Integrated Wireless Monitoring System Using LoRa and Node-Red for University Building	2019
45	[51]	Role of Internet of Things (IoT) for Smart Classroom to Improve Teaching and Learning Approach	2019
46	[52]	Toward a smart campus using IoT: Framework for safety and security system on a university campus	2019

Based on the 46 selected papers, the relationship between keywords is illustrated as in Figure 2.

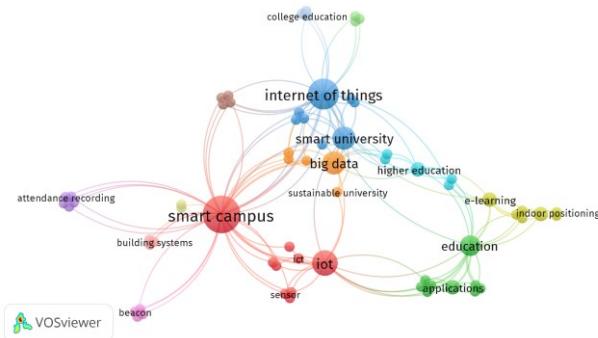


Fig. 2. Network Visualization.

Figure 2 shows the existence of 13 clusters which are detailed in the table below, with the keyword "Smart Campus" being mentioned the most at 13. The second position which is often mentioned is "Internet of Things" 9 times. However, if you look closely, there are similar keywords, namely IoT and Internet Of Things (IoT), so that in total there are 17 times. Other keywords that are closely related to IoT Smart Campus and have received many reviews are: smart university, big data, and education. More details can be seen in table 1

TABLE II. CLUSTER KEYWORD

Cluster	Element
1	Energy Management (1), Energy Management Smart Campus (1), Ict (1), IoT (6), Security (1), Sensor (1), Smart Campus (13), Usn (1), Zigbee (1)
2	Applications (2), Best- Worst (1), Decision Making (1), Education (4), Learning (1), Smart Classroom (1), Teaching (1), Things IoT (1), Universities (1)
3	Augmented Reality (1), Information Communication (1), Internet Of Things (9), IoT Applications (1), Smart University (5), Systematic Literature Review (1), Technology (1), Virtual Reality (1)
4	Bluetooth Low Energy (1), Data Mining (1), E-Learning (2), Indoor Positioning (1), Internet Of Things (IoT) (2), Curriculum (1), Literature Review (1)
5	Attendance Recording (1), Bluetooth (1), Indicator (1), Location Positioning (1), Received Signal (1), Strength (1)
6	Connected Devices (1), E-Learning Environment (1), Higher Education (2), Smart Classroom (1), Smart System (1)
7	Big Data (5), Higher Vocational College (1), Management System (1), Sustainable University (1), University Informatization (1)
8	Android User Interface (1), Electronic Waste (1), Object Detection Model (1), Wearable Device (1)
9	Beacon (1), E-Dashboard (1), Geofence (1), Information System

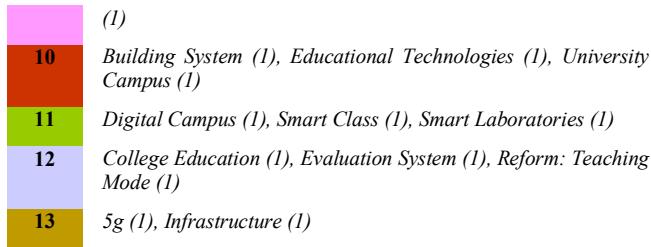


Table II shows what keywords appear in searches via VosViewer. If you look closely, there are several technologies mentioned in relation to smart campuses, namely: Beacon [30], [45], Geofence [30], and Zigbee [27]. These three are technologies that are considered important today. It has been proven that in several applications, technology is the basis used. Examples include: Zigbee is used in student projects in wireless communications for high reliability, good data speed, easy use, low cost, and easy availability. Beacon High School is an application available on the Laystore to make it easier to convey information from the school to students in real time. In fact, in its development with AI, the beacon can detect student behavior and even detect anomalous behavior such as wanting to end one's life. Lastly, Geofence, this technology is used to ensure users are in a "certain area", for example during attendance or checking the whereabouts of lecturers.

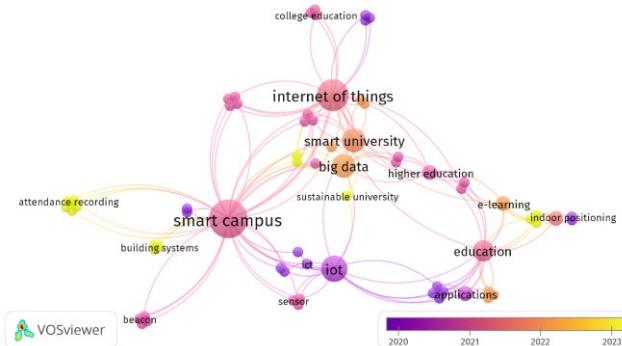


Fig. 3. Overlay Visualization.

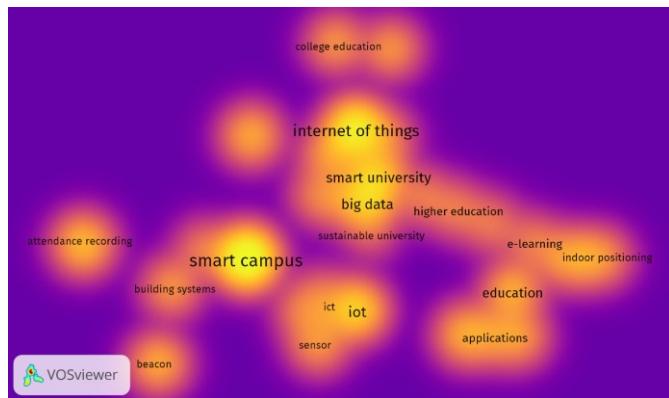


Fig. 4. Density Visualization.

Figures 3 and 4 show that there are still many hot variables to be raised as research issues. Sustainable university is one of the hottest variables to discuss.

4. CONCLUSION

The results of data processing show that there are several technologies mentioned in the journal which is the source of this research. These technologies are Beacon, Geofence, and Zigbee. These three are technologies that are often implemented and are considered important in implementing Smart Campus.

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