Utilization of the IoT System to Minimize the Spread of Covid-19: A Systematic Literature Review

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Abstract— The Covid-19 pandemic has dramatically changed our daily lives, with masks becoming essential to prevent transmission and checking body temperature upon entering public spaces becoming a new norm. The Internet of Things (IoT) technology can aid in implementing health protocols and reducing direct human contact. This research aims to examine and explore the use of IoT systems in minimizing or preventing the spread of Covid-19. This research utilizes a Systematic Literature Review (SLR) method to provide an overview of the topic. According to the findings of the study that was carried out using 15 different journals for review, it was discovered that the object used the most frequently in several research journals is a device for measuring body temperature. Furthermore, most research methods are prototypes, and Arduino microcontrollers are used as the primary component in most of these prototypes. The one strategy for using the internet of things (IoT) to control the spread of Covid-19 is to develop a body temperature monitoring detecting device that can lessen users' need for direct touch with one another.

Keywords— Covid-19, Internet of Things, Social Distancing, Body Temperature Checking, SLR

I. INTRODUCTION

Covid-19 is a virus first discovered in Wuhan, China, in 2019. This virus has hit Indonesia since March 2020 until now. The symptoms of someone contracting Covid-19 are an increase in body temperature, fever, numbness, cough, pain in the throat, headache, and difficulty breathing if this virus has reached the lungs [1]. This virus is transmitted through respiratory droplets produced when an infected person coughs, sneezes, or talks. These droplets can be inhaled by people nearby or land on surfaces or objects, where the virus can survive for some time and then infect a person who touches the surface or object and then touches their mouth, nose, or eyes. This spark can stick to objects and surfaces. When a healthy person touches the splash, and then the person touches the eyes, mouth, or nose, that person can be infected. In current conditions, masks are very important to avoid the spread of Covid-19[2]. Therefore, the government makes policies by enforcing health protocols such as maintaining social distancing, washing hands, and being obliged to use masks if you want to do activities outside the home [3].

However, many people still ignore these health protocols, such as not keeping their distance indoors or in public places and ignoring or forgetting to use masks. These conditions can lead to Covid-19 transmission [4]. Using the Internet of Things (IoT) can be a step in implementing health protocols to minimize the spread of Covid-19 [5]. Technology is very important in protecting the lives of people who always play a role during the pandemic. Big changes can be seen in daily activities with the development of IoT devices and technologies [6]. The Internet of Things (IoT) is part of technology that can provide convenience because IoT transmits data over a network without human-human or human-computer interaction [7].

IoT systems that are commonly used and well-known are Raspberry Pi and Arduino. Raspberry Pi is a small computer that is similar in size to a credit card. It is often used as a foundation for building IoT systems as it has sensors and Raspberry Pi pins that can be programmed to collect data and control devices in the environment [8].

Arduino is an open-source microcontroller that can be easily programmed, erased, and reprogrammed at any time. Arduino is designed to be an inexpensive and easy-to-make device that can interact with the environment using sensors and actuators. Arduino can act as a mini-computer by taking input and controlling output for various electronic devices [9].

The purpose of this study is to review and find out about the use of IoT in preventing or minimizing the spread of Covid-19, as well as inform readers that IoT can provide benefits during a pandemic. In this study, the author uses the Systematic Literature Review (SLR) review method to explore knowledge about the use of IoT technology. Systematic Literature Review (SLR) is a research method that reviews a particular research topic and emphasizes the questions that have been described based on predetermined criteria.

The Systematic Literature Review (SLR) research method is used because it has the advantage of a valid research finding and can be used based on the results of several previous studies.

In previous studies, the authors used a qualitative exploratory research approach. This previous research method aims to determine the phenomena experienced by the object of research in a special context and utilize various scientific

methods. This research is considered less accurate in obtaining the intended results in the current research.

II. RESEARCH METHODOLOGY

This study uses a Systematic Literature Review (SLR) approach with sources from various indexed journals with ISSN. Data collection was done by browsing internet information from Google Scholar.

SLR in Figure 1 is a research method used to collect and evaluate the results of a particular research and topic by identifying, assessing, and concluding existing research results [10].
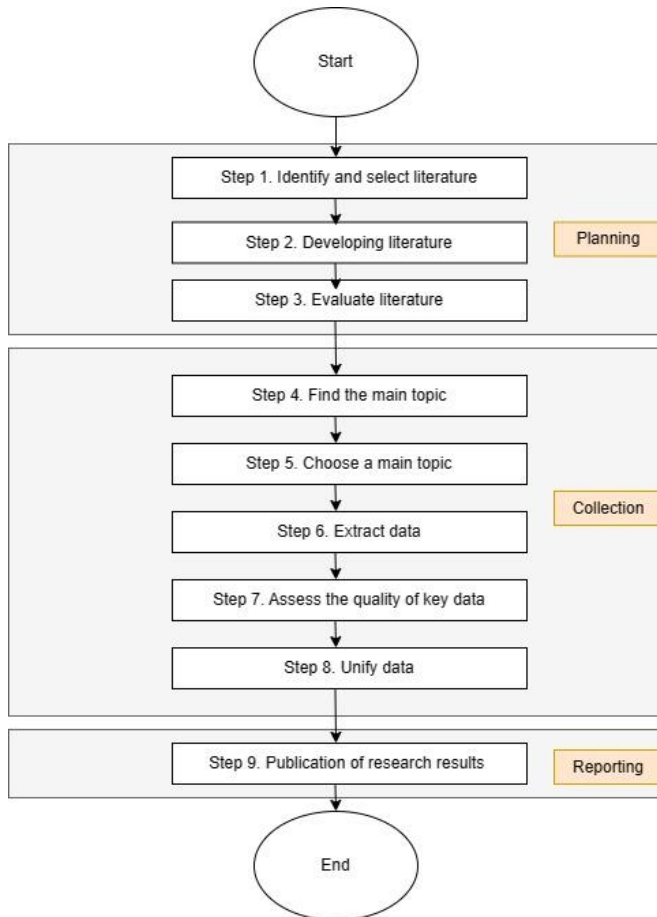

Figure 1. The Systematic Literature Review (SLR) [13]

A. Research Question

Research Questions are the initial part of the research method that uses a Systematic Literature Review as research material and literature. The research questions were formulated based on PICOC criteria, which include population, intervention, comparison, outcome, and context. Table 1 explains the PICOC criteria. Research questions that relate to the chosen topic are in Table II.

TABLE I
PICOC CRITERIA [13].

Population	IoT, Spread of Covid-19
Intervention	Utilizing IoT, minimizing the spread of Covid-19 using IoT, IoT during a pandemic
Comparison	n/a
Results	The use & utilization of IoT in minimizing the spread of Covid-19 during the pandemic
Context	Data collection from journals, public places that are often crowded

TABLE II
RESEARCH QUESTION [13].

ID	Research Question
RQ1	Journal, which is a journal on using IoT to prevent or minimize the spread of Covid-19 in the most significant research?
RQ2	What are the objects of research in related journals?
RQ3	What methods are widely used in research on the use of IoT in preventing the spread of Covid-19?
RQ4	What are IoT components widely used to help reduce the spread of Covid-19?
RQ5	What are the research topics studied by researchers in the use of IoT in minimizing the spread of Covid-19?

B. Search Strategy

The Systematic Literature Review (SLR) search process is done by defining a search string. This string includes several search terms such as: "Utilization of IoT to reduce Covid-19", "Utilization of IoT", "Utilization of IoT against Covid-19", "Covid-19", and "IoT".

Search the digital library database (scholar), including journals and books. Journals must meet conditions where the publication was not more than five years ago. In searching, the appropriate one needs to be selected to increase the chances of getting relevant articles. The search process follows the following steps:

- PICOC search identification terms, especially from population and intervention
- Identify search terms from research questions
- Identify search terms in relevant titles, abstracts, and keywords
- Identify synonyms, alternative spellings, and antonyms of search terms

Advanced search string construction using identified search terms, Boolean AND and OR.

C. Study Selection

1) Inclusion Criteria (Primary study): These are the key features of the target population that will be used to answer questions in a study. The two criteria for the inclusion category included demographic, clinical, and geographic characteristics [11]. Research in the field of IoT in the application of IoT in minimizing the spread of Covid-19 is available in both large and small datasets, with studies that also include comparative discussions on the use of IoT in minimizing and preventing the spread of Covid-19 [12].

2) Exclusion Criteria (Secondary study): It is a study that does not focus on the purpose of the research or strong

validation, use of language that is not in Indonesian or English, and has incomplete literature writing [13].

D. Data Extraction

Data extraction is the selection of data to collect data that has criteria in the form of questions or in the form of question marks that can be used to answer questions. The following is extraction data used in this research listed in Table III.

TABLE III
DATA EXTRACTION OF RESEARCH QUESTIONS [13].

Property	Research Question
Identification and Publication	RQ1
Object of research	RQ2
Research methods for utilizing the use of IoT to minimize the spread of Covid-19	RQ3
IoT Components	RQ4
Research Topics	RQ5

E. Study Quality Assessment and Data Synthesis

Research questions are an important aspect of the research method. Assessing the quality of the studies is crucial to provide direction and evaluating the study's validity, enabling the researcher to draw accurate conclusions from the data. Provide inclusion or exclusion criteria in more detail, see if there are explanations for different learning outcomes, give consideration to individual studies, and provide references for further research [12]. Then, data synthesis aims to collect the results of the selected studies to answer the research questions. In this case, the data were extracted using quantitative and qualitative data, which were then used as material to synthesize data related to the research question [14]. In this study, the information obtained through the literature review will be evaluated based on the following quality criteria questions:

QA1: Were the selected scientific articles published in the 2016-2021 timeframe?

QA2: Did the selected scientific articles write research on the use of IoT systems?

QA3: Do the selected scientific articles describe the use of IoT systems to prevent the spread of Covid-19?

QA4: Did the selected scientific articles write about IoT components being used to reduce the spread of Covid-19?

Each scientific article will be given a score for each answer to the questions above, where the score for Yes is 2, Partial is 1, and No is 0.

III. RESULT AND DISCUSSION

This research review used the Systematic Literature Review method, and fifteen journals researched IoT to minimize the spread of Covid-19. The IoT-based system aims to help organizations implement health protocols to reduce the spread of Covid-19 [15].

After the planning and selection process, only fifteen scientific journals will be used and pass the feasibility study and suitability criteria. Furthermore, evaluating the quality of the scientific articles reviewed is executed. The rating is in Table IV.

TABLE IV
QUALITY ASSESSMENT OF SCIENTIFIC ARTICLES [13].

Reff	Q1	Q2	Q3	Q4	Grades
[16]	Y	Y	Y	Y	8
[17]	Y	Y	Y	Y	8
[18]	Y	Y	Y	Y	8
[19]	Y	Y	Y	Y	8
[20]	Y	Y	Y	Y	8
[21]	Y	Y	Y	Y	8
[22]	Y	Y	Y	Y	8
[23]	Y	Y	Y	Y	8
[24]	Y	Y	Y	Y	8
[25]	Y	Y	Y	Y	8
[26]	Y	Y	Y	Y	8
[27]	Y	Y	Y	Y	8
[28]	Y	Y	Y	Y	8
[29]	Y	Y	Y	Y	8
[30]	Y	Y	Y	Y	8

Explanation: (Yes(Y)= 2/Partial(P)= 1/No(N)= 0)
Total score = 120 of the total perfect score of 120. Percentage of Value = (120/120) *100% = 100%, meaning that the scientific articles that have been reviewed have met the needs based on the Quality Assessment of Scientific Articles.

The discussion is done on each question determined in the Research Question (RQ) section.

RQ1: Journal which is a journal on the utilization of IoT to prevent the spread of Covid-19 in the most significant?

In this SLR discussion, fifteen journals analyze the use of IoT to reduce or minimize the spread of Covid-19. In 2020 some journals reviewed the Internet of Things system to reduce the spread of Covid-19. Moreover, in 2021 there are several journals with prototype methods and exploratory and qualitative studies discussing the use of IoT systems to reduce the spread of Covid-19.
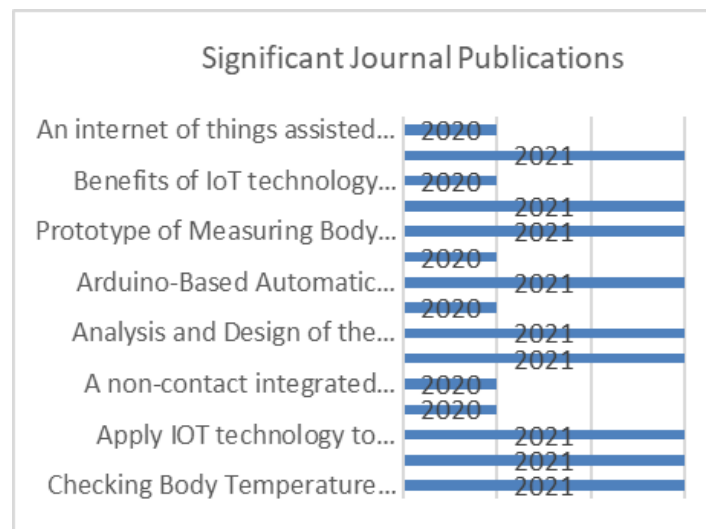

Figure 2. Graph-Based on significant journal publications

RQ2: What are the objects of research in related journals?

The object of research used by each journal that has been taken is different. Several journals discuss more than one object. Objects as seen in Figure 2.
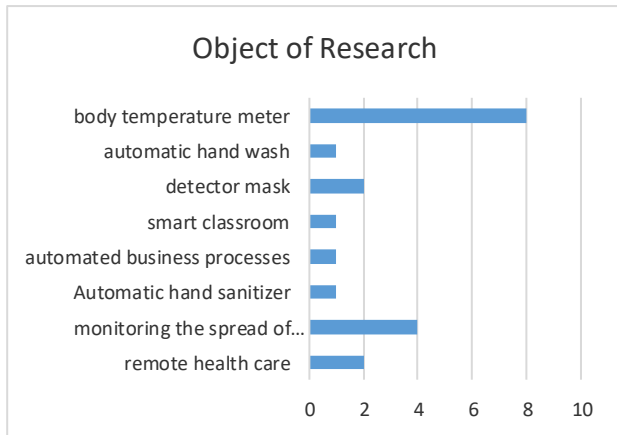

Figure 3. Journal Graph Based on Research Object

The graph in Figure 2 shows that the most widely studied object in research is the temperature gauge. The use of IoT in temperature measurement systems is discussed in 8 articles. The temperature measurement uses IoT devices such as the Arduino IDE (Arduino integrated development environment), Intelligent Pandemic Prevention Temperature Measurement System (ITMS), Pandemic Prevention Situation Analysis System (PPAS), Arduino microcontroller, relative humidity (RH) sensor, and infrared sensor. The second most researched object is monitoring the spread, which is discussed in four articles. The remaining articles cover different research objects.

RQ3: What methods are widely used in research on the use of IoT in preventing the spread of Covid-19?
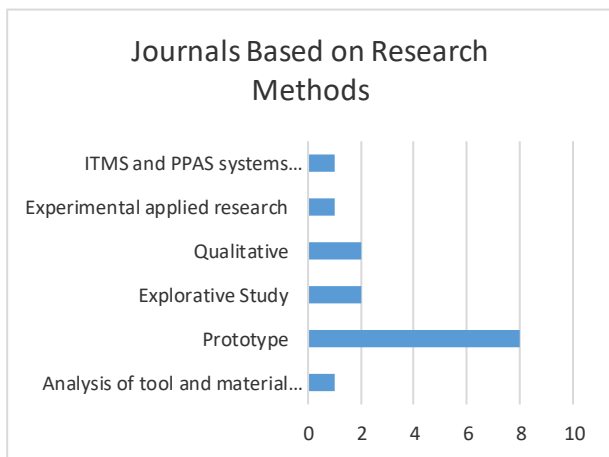

Figure 4. Journal Graph Based on Research Methods

The research method used by the journal that has been produced is in Figure 3. Based on the graphic diagram above

from fifteen research journals regarding IoT in preventing the spread or minimizing Covid-19, the prototype is the first widely used research method. There are eight journals, followed by the second qualitative and exploratory study consisting of two journals each. , and the rest are different methods.

RQ4: What IoT components are widely used to help reduce the spread of Covid-19?

The IoT components used in the journals reviewed to aid in reducing the spread of Covid-19 are presented in graphical form in Figure 4. Based on the graphic diagram in Figure 4 was obtained from fifteen research journals that used the most IoT components to reduce the spread of Covid-19, based on the Arduino microcontroller. There were five journals; the second most used AI contained three journals, while the rest used various components.
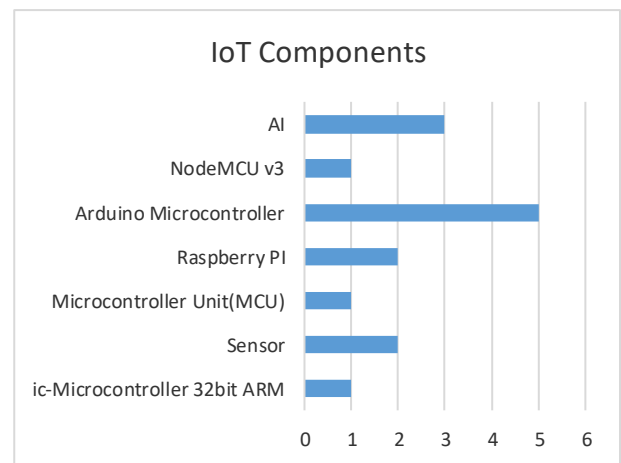

Figure 5. IoT Component Graph

RQ5: What are the research topics studied by researchers in the use of IoT in preventing the spread of Covid-19?

The research journals selected on the use of IoT in preventing the spread of Covid-19 as described in Table V.

- Provide solutions in the form of products or prototypes using IoT to prevent the spread of Covid-19.
- Provide proposals for making tools that use or utilize IoT to prevent the spread of Covid-19 in Figure 5.

TABLE V
RESEARCH TOPIC [13].

Reff	Methods	Results
[16]	Prototype	The entrance portal is an automatic body temperature measuring device without making direct contact. Every visitor who enters a certain area will have their body temperature recorded and ensure that it is within the allowed range. Body temperature monitoring is carried out by displaying numbers and through a web page display in real-time, where the visitor's body temperature data is sent to the internet

Reff	Methods	Results
		network and stored in the cloud.
[17]	Analysis of tool and material requirements, observation techniques	The result is an automatic hand-washing device. The working system of this tool does not touch the water faucet or soap box. In addition, this automatic hand washing tool is also useful for automatic hand drying using a fan, thereby reducing tissue waste and the use of air.
[18]	ITMS and PPAS system planning and development	Using a Pandemic Prevention Situation Analysis System (PPAS) and an Intelligent Pandemic Prevention Temperature Measurement System (ITMS) in applications to monitor who enters and exits the facility. ITMS has functions such as identity recognition, autonomous detection, voice guidance, and remote surveillance. The PPAS can provide historical data traceability, bulk data monitoring, pre-alert analysis, and post-infection analysis.
[19]	Prototype	Detection of mask usage in public spaces. The detector will warn if a person is not wearing a mask. It can also determine whether the distance between individuals is safe or not, based on the recommended two meters distance. Each person will be marked with a box.
[20]	Prototype	The platform built is integrated with non-contact sensors for remote body temperature monitoring. Body temperature data is measured with a traditional thermometer. Each was measured five times at different times of the day.
[21]	Prototype	This diagram illustrates the processes and sequence of messages exchanged between them to perform the functionality [20]. Including (i)creating an account in Figure 15, (ii)login in Figure 16, (iii)inputting the menu in Figure 17, (iv)inputting the purchase of material stock needs in Figure 18,(v)viewing stock data (receiving and performing material stock requests) in Figure 19, (vi)placing sales orders in Figure 20, (vii)view transaction reports (printing transaction reports) in Figure 21, and (viii)deleting an account in Figure 22.
[22]	Study Eksploratif	In this study, the authors explain that IoT technology can be very efficient in helping to reduce the adverse effects and survive this pandemic. Still, the authors suggest that IoT technology must be applied appropriately and safely. So as the benefit of IoT devices can be felt by many people.
[23]	Prototype	Detector masks using IoT-based telegram notifications can function properly, detect masks used by humans, and provide notifications to security officers.
[24]	Study Eksploratif	The author discusses the application of IoT technology, which can be implemented in three stages, which are referred to as the "diagnostic period," the "quarantine period," and the "healing period," respectively. An assessment is performed at each level to

Reff	Methods	Results
		determine how various effective technologies, such as drones, robots, IoT buttons, and smartphone applications, are in the fight against COVID-19. These technologies include those that support or are related to IoT. During this pandemic, the internet of things technology is quite effective. However, protecting one's data privacy while making appropriate use of it is also of the utmost importance.
[25]	Experimental Applied Research	The detector for measuring body temperature will issue an alarm if the body temperature is too high. The tool uses an Arduino outfitted with sensors and Bluetooth to communicate data to a mobile device, laptop, or desktop computer.
[26]	Prototype	Smart helmets are integrated with a thermal system. They can detect body temperature, screen, and the history of places users visit by viewing Google's location history with the details provided.
[27]	Qualitative	The protection of medical personnel is not considered important; therefore, this journal proposes a double step in protection using the DBCMS method that can work effectively if implemented.
[28]	Prototype	In the trial results, using facial recognition by scanning body temperature and masks can reduce interactions between humans in public places. IoT plays a role in preventing or minimizing the spread of Covid-19.
[29]	Prototype	The prototype of measuring body temperature using IoT and based on a website can be used by displaying body temperature. Still, this research has not been carried out directly in the field, so it cannot be known about the appropriate sensitivity level of the *IR* sensor.
[30]	Qualitative	Propose the IoT and the combined fog cloud of Covid-19 prevention and control by implementing five NPIs, including diagnosis of Covid-19 symptoms, quarantine monitoring, contact and distance tracing, and SARS-CoV-2 mutation tracking.

Many different prototypes, ideas, and concepts have been generated directly from reading about the study issues discussed in the publications that served as the basis for this research. The use of prototypes is the most common approach. The body temperature measurement device was the prototype that progressed the most toward the optimum state.

From the various kinds of innovations in the use of IoT given to these journals, they can provide solutions to preventing the spread of Covid-19, which is happening right now. This positively impacts the pandemic situation that has lasted for two years in Indonesia.

IV. CONCLUSION

The results of all studies using the Systematic Literature Review research method, which have reviewed 15 research

journals regarding the use of IoT in preventing or minimizing the spread of Covid-19, conclude that based on the discussion described above, the journals reviewed are following the percentage of 100%. These findings are evaluated based on an analysis of the quality of the studies and the data synthesis that was conducted. This analysis generates a score for each scientific journal based on the questions posed, and it utilizes journals with publication years ranging from 2020 to 2021 and taking into account the discussion of the internet of things. The Covid-19 pandemic is the main discussion of the journal. The object of research related to the pandemic, the research methods carried out, and the results of journal research can provide benefits for the prevention of Covid-19, which are the assessment of the results of this study.

Based on the 15 research journals' findings, a body temperature measurement detection device was identified as the most frequently used object in multiple research journals. Prototypes were the most common research method, and Arduino microcontroller-based components were used in most research components. In this way, one of the strategies for utilizing IoT that can be used to minimize or prevent the spread of Covid-19 is to innovate a body temperature measurement detection device to avoid direct contact with other users. This is one of the solutions that can be used to use IoT to minimize or prevent the spread of Covid-19. In addition, it proves, based on a review of 15 journals, that the IoT can aid in minimizing the spread of the Covid-19 virus, particularly in public settings.

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