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# Smart Farming Using Robots in IoT to Increase Agriculture Yields: A Systematic Literature Review

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*Abstract*—**Robots are beneficial in everyday life, especially in helping food security in the agricultural industry. Smart farming alone is not enough because smart farming is only automated without mobile hardware. The existence of robots can minimize human involvement in agriculture so that humans can maximize activities outside of farms. This Study aims to review articles regarding robots in smart farming to increase agriclture yields. This article systematically uses the systematic literature review method utilizing the Preferred reporting items for systematic review and meta-analyses (PRISMA) by submitting 3 Research Questions (RQ). According to the authors of the 3 RQs, it is necessary to represent the function and purpose of robots in farms and to be used in the context of the importance of robots in agriculture because of the potential impact of increase agriculture yields. This Research contributes to finding and answering 3 RQ, which are the roots of the use of robots. The results taken, the authors get 116 articles that can be reviewed and answered RQ and achieve goals. RQ 1 was responded to with the article's country of origin, research criteria, and the year of the article. In RQ 2 the author answered that Research often carried out 6 schemes, then the most Research was (Challenge Robots, Ethics, and Opinions in Agriculture) and (Design, Planning, and Robotic Systems in Agriculture). Finally, in RQ 3, the author describes the research scheme based on understanding related Research. The author hopes this basic scheme can be a benchmark or a new direction for future researchers and related agricultural industries to improve agricultural quality.**

***Keywords***— ***Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA); Robot; Smart Farming; Systematic Literature Review.***

## I. INTRODUCTION

Occupation growth hurts natural resources because the limited availability of land decreases, and the temperature increases due to global warming. The increase in the amount of carbon is an impact that results in a drastic rise in humidity and temperature, thus making food security a significant concern and limited natural resources and the need for food security in many countries [1]. These days, governments are trying to meet their own country's food needs. After obtaining food security, then a country will export its products to other countries. In this case, it is not easy to maintain food security. Many countries work together to create food security. One solution to help with this problem is appropriate technology, which can effectively and efficiently increase the yield of food originating from agriculture or plantations. This technology needs to be connected to the Internet to fulfill the requirements for effectiveness and edition. This technology is also called Internet of Things (IoT) [2].

These days, almost everything is connected to the Internet. This integrates the created systems and objects to make it easier to automate these objects. One of the related technologies in this regard is the IoT [3]–[14], IoT technology can automate all objects that come from monitoring in an integrated manner, and this automation can reduce the failure rate of production objects. This technology is so efficient that it is widely used as a solution. Especially in agriculture because several studies have explained this technology's agricultural improvement [15].

Smart Farming has many structures starting from the latest technology and incorporating several other technologies such as Artificial Intelligence (AI). Increased food is detected by IoT, which can provide new data and increased automation and the data results are made for detection or forecasting with AI. This technology is very effective because it uses Machine Learning (ML) [16]–[22], or using Deep Learning (DL) [23]–[30] where the method can always learn according to the data obtained [31].

Some of these things are not enough and still depend on simple things. So one application that can significantly assist in this increase is autonomous robots that can help apart from agricultural monitoring and work directly in a farming environment. This keeps human labor to a minimum. Robot technology can move agilely on agricultural fields without human intervention in monitoring environmental parameters with the help of an IoT device installed on it [32].

Recently there has been a lot of work in agriculture involving robotics because it can do work autonomously as jobs related to weeding and harvesting are approached with seeding and disease detection, according to a recent study on the commercialization and Research of agricultural robots for field operations [33]. For example, spreading fertilization can be utilized independently with an autonomous vehicle robot, but this system still requires human intervention, such as fueling the Robot, maintenance, and providing fuel [34].

Due to many studies on Robots in Smart Farming, it is challenging, and there are many gaps in reviewing these studies. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) [35], [36], because it is very systematic in doing reviews. Many studies also use PRISMA more because of its dynamic nature. Research usually upgrades its utilization to obtain results that are more systematic and per the author's needs. So the authors in this review use PRISMA to make the results more reasonable and produce valuable reviews. Because there have been many studies related to reviews, the authors started looking for opportunities that exist in doing reviews through several previous studies.

Previous Research [37], reviews on smart farming only discuss artificial intelligence's influence on improving smart farming, whereas Machine Learning and Deep Learning can only carry out the effect. But artificial intelligence is only used based on existing input or data. One cannot rely solely on AI to carry out actions and reactions. Here, the author wants to show that the actions needed can only be created by robots, of course, with the help of IoT and AI.

Thus, the authors see a challenge, opportunity, and gap for this Research. The author wants to answer some questions that have not been resolved in previous Research so that this gap can be resolved using PRISMA review research related to smart farming, which has been carried out but is still rare in applying Robots in IoT, especially in smart farming. The author has the opportunity to review IoT robots to increase the quality of smart farming.

The contributions that the authors present in writing this systematic literature review are listed below:

• The author wants to see the source of the Research, year of origin, and country. To recognize the research trend.

• The author tries the function scheme of Robots that can help smart farming to increase agriculture yields.

• The author deciphers the results of research schemes that can increase agriculture yields provided by robots in smart farming.

Finally, this Research is divided into several parts. Part 1 is the background and reasons why this Research is needed, Section 2, discusses related Research that has been carried out and opportunities for authors to do research reviews. Section 3 is the method used by the authors, which is PRISMA. Section 4 is the results that will answer the research question (RQ). Section 5 is the conclusions and suggestions that the author will present.

## II. Literature Review

Several studies related to reviews have been carried out, especially in reviewing smart farming. Study [38], explained smart farming from the IoT side, which aims to identify its main devices, such as network protocols, platforms, application of renewable technologies, and data processing. Its review shows there have been rapid changes in the way data is processed in recent years. Study [39] applies various methods in maximizing agriculture in agricultural monitoring, especially in remote areas focused on plants. The Study of smart farming architecture and various smart farming techniques has classified smart farming techniques into three categories: IoT-based agricultural monitoring and control systems, automatic irrigation systems, and plant disease monitoring systems. Study [40], describes the increase in information resources from the field of agriculture day to day to make smart farming transform and then can be used in learning systems to make it smarter. Deep learning (DL) applied to ML uses the principles of artificial neural networks. The main thing that differentiates which are DL networks from neural networks is their features and depth. DL network that does not require human intervention. The focus of this Study is to explore the advantages of using DL in smart farming.

Study [41] Review new approaches to smart farming from 2019 to 2021, where the Study focuses on reviews that illustrate if smart farming performs data storage, data collection, analysis, transmission, and appropriateness solutions. IoT in smart farming is an important component of the smart system. On the other hand, this work shows the importance of using the latest networks, such as 5G, in facilitating intelligent systems, as these networks deliver high-speed data transfers, up to 20 Gbps. The last Study [42] focuses on agricultural systems that utilize AI to improve the quality of agriculture. Some of these technologies are widely applied to basic fields. This smart thing is needed to increase agriculture yields in various regions, especially AI's role in determining and predicting. Therefore, a systematic literature review of studies aims to gather trends in AI studies for Smart Farming articles using the latest year features from 2018-2022.

Some previous research still discussed reviews on AI and IoT to help smart farming, but this is crucial because there is still a lack of systematic literature review research in understanding the roles, problems, challenges, and solutions that can be solved by utilizing robots. So that there are gaps and benefits that the author can provide for further reviews or for comparative studies in the industry. Because of this reason, the gap that the author has obtained needs to be put to good use in solving this problem by answering RQ to find and contribute suitable Research.

In the next section, we will focus more on using PRISMA as a systematic review, starting from the stage of why to use it to the stage of finding the appropriate article to answer each RQ.

## III. Research Method

There has been a lot of Research on reviews using the Systematic Literature Review, which continues to develop or has been published in recent years. Some researchers need a detailed analysis to see a new point of view. It is used to examine some of the methods suitable for review research. A systematic literature review of these conditions is used in looking at several studies related to robots, the use of robots is very much, but a systematic literature review focuses on robots in smart farming. Where a lot of Research. So the PRISMA method can help in seeing the uniqueness of some of these studies.

The PRISMA used to make it easier for writers to carry out systematic searches. There have been studies (inspired by previous Research) [37], [43]. This systematic literature review, the author makes use of PRISMA and sequences according to the PRISMA rules. Fig. 1 will show the Methodology Flowchart (inspired by previous Research [37], [43]). The author also uses Fig. 1 as a basis for why PRISMA is more usable in the article search process as a solution to robot issues in IoT to increase agriculture yields.

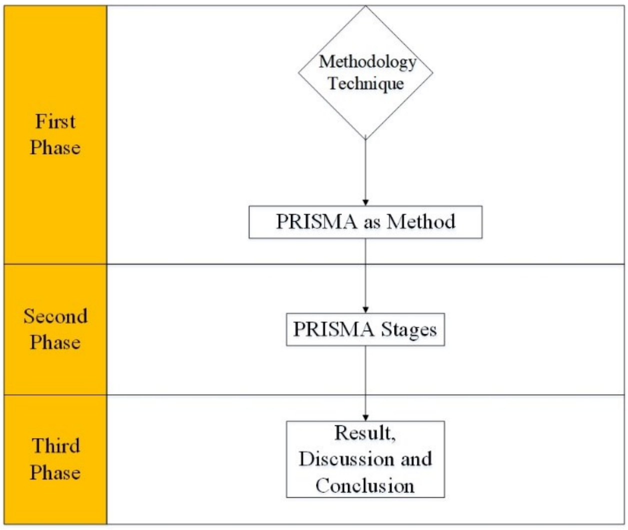


Fig. 1. Research flowchart

Fig. 1, the author has described several stages of PRISMA, namely (looking for articles, PRISMA Stages, Results, and final discussion) (Inspired by previous Research) [37], [43] ).

Several stages are described as follows:

1. Choose a systematic literature review (SLR) methodology after looking and thinking about the PRISMA reference that the author chose.
2. Carry out the steps in PRISMA as a SLR solution. This step which articles are taken from sources that must be reputable and internationally indexed, made using good and correct English. After that, the data is synthesized and analyzed before finally being able to retrieve the appropriate one.
3. PRISMA got result that can use in defining results, discussions, and conclusions. This stage has been fully synthesized and analyzed to make the results very feasible.

### *A. Research Question*

Research Questions (RQ) in this review research are used to keep the research review process in line with the original purpose of this scientific article. The PRISMA criteria were used to design this Research. To understand this, the authors did Research based on RQ and Aimed to stay on track, shown in Table I.

TABLE I. THE RESEARCH QUESTION AND AIMS

| No | Research Question (RQ) | Aims |
|---|---|---|
| 1 | How to see the source of the research country, year of origin, and criteria. To recognize the research trend? | Presenting the source of the research country of origin, year of origin, and criteria. To recognize the research trend |
| 2 | What is the function scheme of Robots that can help IoT for smart farming? | Propose a functional scheme of Robots that can help IoT for smart farming |
| 3 | How to decipher the results of research schemes that can increase agriculture yields provided by robots in smart farming? | Presenting the results of research schemes that can to increase agriculture yields provided by robots in smart farming |

### *B. Research Strategy*

The author uses this step in carrying out a strategy for selecting article sources and determining search methods using PRISMA. This also includes creating searches, searching words, and how to collect articles. The author makes a strategy starting from 2018-2022. The Study searched for articles on highly correlated robots that focus on smart farming to improve the quality of agricultural produce. Which articles are taken from sources that must be reputable and internationally indexed, made using good and correct English.

At this time, it is done by searching for details of terms, such as ("Robot" OR "ROBOTIC") and ("Smart Farming" OR "Precision Farming") and ("Smart Agriculture" OR "Precision Agriculture") and ("Robot Farming" OR "Robotic Farming") and ("Robot Agriculture" OR “Robotic Agriculture) and ("Robot Smart Farming" OR “Robotics Smart Farming) and ("Robot Smart Agriculture" OR “Robotic Smart Agriculture) and ("Robot Precision Farming and Robotic Precision Farming") and ("Robot Precision Agriculture OR Robotic Precision Farming") related to ("IoT" OR "Internet of Things) and some related research that can increase the quality of agriculture yield. This stage is one of the first syntheses and analyses, so the article follows the keywords used.

### *C. Selection Criteria*

The author is looking for several articles from 2018 – 2022. The next step is a screening article that discusses Robots in Smart Farming and the surrounding environment in improving crop quality. However, the article you are looking for must focus on smart farming and its application so that its basic function is still formed in increasing agriculture yields, not discussing other points. In this review research, several stages were used in selecting criteria, 1 identification, 2 screening, 3 eligibility, and inclusion. In this review, Research can also focus on Research in review as well as other related Research. These steps are used to avoid the potential for bias.

In this stage, the article is also re-synthesized to determine whether it is appropriate, not just the keywords, but is in accordance with the desired criteria. The selection criteria need a very detailed analysis and do not extend from the topic you want to use.

At this stage, analysis and synthesis are carried out almost repeatedly, mainly because much more relevant Research is out of the year. But the research focus cannot change in order to get results that are on the topic with the appropriate analysis or synthesis.

### *D. Quality Assessment*

The articles taken are from internationally indexed articles which produce 5864 articles. Furthermore, the authors identify in order to see the important factors. This stage resulted in 4567 articles that needed to be excluded and left 1297 articles on screening. Then in the next stage, there are 754 articles obtained and need to be excluded, 543 articles remaining at the eligibility stage. Then, in the next stage, 116 articles were analyzed and 427 articles were excluded. So that in the end, only 116 were found which became the benchmark in the study. To Avoid potential biases in the search strategy or limitations in the quality of the included studies, the author reconfirmed several times in determining the results of the 116 articles. So hopefully, there is no bias.

At the end of these 116 articles, a proper analysis was carried out again before proceeding to the discussion. But according to the author, there is no change, so it can be continued to the discussion and results section.

## IV. RESULT AND DISCUSSION

This section focuses on the results of the methodology described in the previous section so that a more detailed explanation of the use of PRISMA [36], along with details (and inspired by previous pattern Studies [38] and [37]) concept used, as shown in Fig. 2.

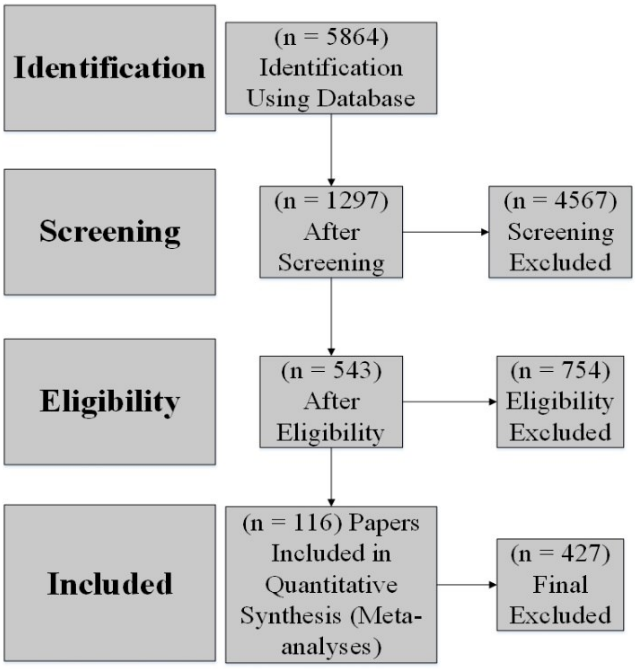


Fig. 2. Research PRISMA flowchart

Fig. 2 presents several phases and stages of the PRISMA search that the author has carried out in reviewing the Research in this systematic literature review. In Fig. 2 the author searches research articles from online sources and stays on the previous core presentation, namely the Study of Robots in Smart Farming to improve the quality of agriculture yields. The author focuses on finding robot articles on smart farming that are useful in enhancing agriculture yields.

Fig. 2 also explains that the author has made good use of PRISMA, and reasoned to minimize bias. The PRISMA stages themselves can minimize bias properly so that the author can answer each RQ from the results of Fig. 2. After that. The author will answer several research questions presented in several sections below.

### A. *RQ 1: How to see the source of the research country, year of origin, and criteria. To recognize the research trend?*

Previously it was explained that if articles are taken only from journals or conferences that are indexed internationally and come from years that meet the criteria, it is at this stage of the criteria that the analysis and synthesis are carried out properly and correctly, and the Research will be explained.

- Where do articles come from?
- Whether the Research comes from a journal or conference.
- What year was the article published.

In answering where the article comes from, Table II presents an explanation table from which country the author made the article (focus on the first author).

TABLE II. ARTICLES BY COUNTRY

| Country | Result |
|---|---|
| USA | 10 |
| India | 10 |
| Japan | 10 |
| Greece | 9 |
| China | 7 |
| Norway | 7 |
| United Kingdom | 7 |
| Germany | 7 |
| Italy | 5 |
| France | 4 |
| Spain | 4 |
| Netherland | 4 |
| Australia | 4 |
| Portugal | 3 |
| Denmark | 2 |
| South Korea | 2 |
| Iran | 2 |
| Indonesia | 2 |
| Turkey | 2 |
| Kazakhstan | 1 |
| Israel | 1 |
| Pakistan | 1 |
| Canada | 1 |
| Nigeria | 1 |
| Chile | 1 |
| Nigeria | 1 |
| Pakistan | 1 |
| Colombia | 1 |
| New Zealand | 1 |
| Fiji | 1 |
| Bulgaria | 1 |
| Mexico | 1 |
| , Philippines | 1 |
| Czech Republic | 1 |

Table II shows the results of lighting the authors systematically, where the Table II presents several countries that produce articles that focus on Robots in Agriculture (focus on the first author). The Table II shows that the USA, India, and Japan published 10 articles. This shows that the three countries are indicated interested in Research on robots in smart farming to increase agriculture yields so that it can be a reference in seeking related Research. After that present a the originating article (conference or journal). Criteria are presented in Table III.

TABLE III. ARTICLES BASED ON CRITERIA

| Database | Result |
|---|---|
| Journal | 99 |
| Conference | 17 |

Table III presents the results based on research criteria (Journal or Conference). The results show that many Journal Articles have been published on Robots in Smart farming to increase agriculture yields. This Research is more often published in the form of journals than in conferences. Next, reference in preparing this systematic literature review article, as shown in Table IV.

TABLE IV. ARTICLES BASED ON PUBLICATION YEAR

| Publication Year | Result |
|---|---|
| 2018 | 19 |
| 2019 | 20 |
| 2020 | 30 |
| 2021 | 25 |
| 2022 | 22 |

Table IV presents published mostly in 2020, 2021, and 2022. The author believes that a lot of Research is presented in 2020, 2021 and 2022. So that it can be seen that Research on robots in agriculture in improving crop quality has not decreased significantly or is always updated with other latest technologies.

*B. RQ 2: What is the function scheme of Robots that can help IoT for smart farming?*

In this section, the author will present several research concepts often used in robotic Research in smart farming to increase agriculture yields to answer the question. The author presents in Fig. 3.

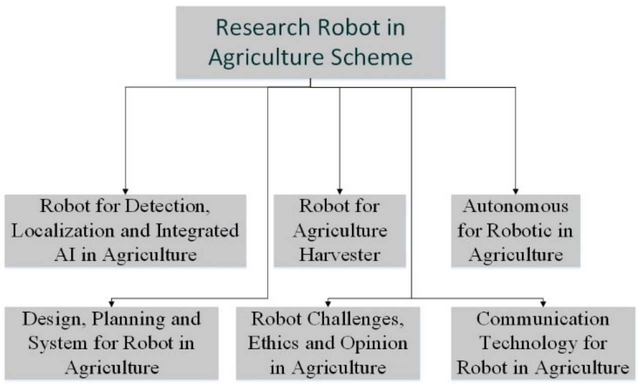


Fig. 3. Robot Agriculture Scheme

Fig. 3 shows the schemes that are usually used in Research on robots in agriculture to increase agriculture yields. Some of these factors help agriculture improve the performance of smart farming. The author also presents the results of Table V how many related studies are included in the following Table V scheme.

TABLE V. RESULT TABLE FOR RESEARCH SCHEME

| NO | Research Robot in Agriculture Scheme | Result | Total |
|---|---|---|---|
| 1 | Robot for Detection, Localization and Integrated AI in Agriculture | [34], [44]–[59] | 17 |
| 2 | Robot for Agriculture Harvester | [60]–[81] | 22 |
| 3 | Autonomous for Robotic in Agriculture | [82]–[93] | 12 |
| 4 | Design, Planning, and System for Robots in Agriculture | [94]–[122] | 29 |
| 5 | Robot Challenges, Ethics and Opinion in Agriculture | [123]–[152] | 30 |
| 6 | Communication Technology for Robots in Agriculture | [153]–[158] | 6 |

Table V shows the results of the number of studies that focused on the schemes made by the authors. It is evident that in the 2018-2022 range, many related studies focused on schemes (Robot Challenges, Ethics and Opinion in Agriculture) and (Design, Planning, and System for Robots in Agriculture). So that it can be drawn that the core of the Research is still focused on the design and opinions. The author will be provided a more in-depth analysis of the result in RQ 3 and a discussion.

*C. RQ 3: How to decipher the results of research schemes that can increase agriculture yields provided by robots in smart farming?*

To fulfill this research question, the author will explain some of the results of the schemes, which are broken down into several parts, and will explain in more detail the 6 existing schemes.

1). Robot for Detection, Localization, and Integrated AI in Agriculture

As Show Table V explains, if number 1, this scheme is often used by researchers mainly because of the high utilization of artificial intelligence in localizing Robot in IoT to increase agriculture yields and help solve agricultural problems. Where there are 17 articles It's no stranger to using AI in all fields, especially in its use in smart farming. In this case, robots need to act intelligently to detect, localize, recognize, and learn.

According to [58]. Smart farming requires a detection system, in this case, real-time and accurate image-based multi-class fruit detection. It should be noted that harvesting using robots can reduce costs and improve quality. This Research attempts to propose a deep-learning framework for fruit detection.

According to [44], intelligent agricultural robots have been widely applied, especially in smart farming, but it is necessary to estimate their position accurately. Thus, this Research attempts to establish a mapping and localization system to address challenging agricultural scenarios. This localization is needed to understand where the Robot is in its role of helping smart farming. With this, the Robot will be easy to estimate its location accurately.

2). Robot for Agriculture Harvester

As Show Table V explains number 2, schemes to assist in reaping agricultural produce or even making machines, usually Robot in IoT to increase agriculture yields, are heavily emphasized here, with as many as 22 articles in addition to its established function in integrating AI and robots. Another factor that affects agriculture is harvesting. Many things usually influence good yields. One of them is fertilization, watering, and irrigation, then several other factors.

According to [65], there are important critical times when more workers are needed than usual agricultural work. However, there are also conditions where there are very many jobs and few jobs. To harvest, sometimes you only have a certain time at harvest. Therefore, his Research focuses on developing tomato harvesting robots that can be used as temporary workers.

According to [68], there is a shortage of harvesting when humans climb trees (in this case, coconut trees) to harvest coconuts in India and other developing countries. So his Research uses a robot called Amaran, or a robot harvester, and coconut trees. Robots can be controlled, through a wireless interface, so utilizing robots in harvesting is needed, especially because of the benefits that can reduce costs and the risk of accidents occurring to humans.

3). Autonomous for Robotic in Agriculture

As Show Table V explains number 3, this scheme is used by researchers in reducing human involvement in agriculture robots in IoT to increase agriculture yields, of which there are 12 articles. In maximizing robot performance, an autonomous robot is needed here that can work and think for itself. This can facilitate human work because the Robot can handle all forms of action and reaction.

According to [83] trying to present a plan for the automatic motion for agricultural robots because it has many advantages that make it possible to make robot settings follow the specified direction in helping agriculture. Autonomous robots also have problems, such as autonomous navigation, when applied to agriculture. So indeed, the nature of autonomy is very important for robots to help improve the quality of plants in smart farming.

According to [84]. Mentioned that in automation, robots have an important role in increasing agricultural production. The common systems that are now available are usually carried out for identifying pests and weeds. That method utilizes machine learning, in some cases, autonomous weed control. Not only that, but autonomous is also used in vegetable and fruit harvesters. So there is a lot of Research on the availability of autonomous machines in agriculture. This is an opportunity for some research on autonomous systems in robots on intelligent agriculture to increase agriculture yields.

4). Design, Planning, and System for Robots in Agriculture

As Table V numbers 4, researchers are used as an initial step to get a suitable robot in agriculture. This is important because each region has different characteristics that affect the design of the Robot in IoT to increase agriculture yields, of which there are 29 articles. The Robot is not only applied but has an initial design for its formation and even has a special plan. To create a system or platform that can be used on robots to increase agricultural output.

According to [102]. Explaining agriculture takes a technology that is practical and used by farmers. As with sowing seeds, it requires good technology design, such as robots, where the Robot's position can be desired to help farmers save time and money. So we need an appropriate and useful design so that the seeding process is not arbitrary and does not harm farmers.

According to [96], This Study attempts to describe the development of tool design in agricultural management emulation, which aims to make agriculture effective in introducing digital technology to the world of agriculture. The results of the research design analysis show that simulation and emulation modeling has been applied. A Robot Operating System can be used to conduct an efficiency assessment in the agricultural sector. So that it can be concluded that if, indeed, robots in intelligent agriculture need to be designed and planned to make a good robotic system in increasing agriculture yields.

5). Robot Challenges, Ethics, and Opinion in Agriculture

As Table V numbers 4, robots are usually used remotely, and this difference must be remote. So communication is needed. This communication is an important research robot in IoT to increase agriculture yields. As the need for robots in agriculture increases, there are also opinions regarding the application of these robots, especially the ethics, perspectives, and challenges. This also means that there are pros and cons to implementing this Robot. So it is important to see that point of view.

According to [148], Using robots in smart farming has been very helpful in agriculture itself. However, some questions exist regarding the dilemmas of responsibility, ethics, data protection, privacy, and regulatory aspects in each city or country. Some of these questions need to be asked because something that is excessive and cannot be regulated makes things more easily spread and violate existing norms.

According to [150], explained that agriculture is very developed now because this development creates new technologies that are effective and efficient. There are now so many of them that some researchers believe that developments in robotics engineering will revolutionize the agricultural domain. This Research surveys the future of robotics for agriculture, and also discusses its possible impact, and examines ethical and policy questions that may arise. This Robot may have an economic and environmental impact, so there is still a need for a major policy to meet the ethical challenges that may arise in the application of agricultural robots in improving agricultural quality.

6). Communication Technology for Robots in Agriculture

Finally in Table V, number 5. Usually discussed by researchers, because there are pros and cons in implementing the Robot in IoT to increase agriculture yields, of which there are 30 articles. Smart farming is inseparable from how to control robots in their environment. One of the functions of this control is a communication tool between the Robot and the user. Maybe robots are not needed even to save energy.

According to [153], research was conducted on the evaluation and design of the presented sprinkler irrigation robot architecture. Irrigation is important in agriculture, and irrigation control is carried out using ZigBee communication designed to provide efficiency. There are many other communication devices besides using ZigBee. Because of the importance of communication in one of the robotic controls, wireless communication is increasing.

According to [157] conducting Research in conducting automation in agricultural systems. Because there are deficiencies in conventional farming systems, automatic remote control to control the Robot needs to be proposed to fill the water usage in the agricultural domain. The system is usually called smart irrigation. It is proposed that the use of remotely controlled robots be developed. The control communicates with the Robot to various sensors, and a highpixel camera is attached to the Robot. The importance of communication in the formation of robots is very helpful in improving the performance of robots in smart farming.

### D. Discussion

In this study, the authors focused on 3 RQs, where each RQ author encountered difficulties in developing robots in agriculture, especially in the use of IoT to increase agriculture yields. As in RQ 1; most Research comes from the USA, China, and India, which is the type of journal, and in 2020 is the most Research.

Then in RQ 2 it turned out that the most Research was "Challenges of Robots, Ethics and Opinions in Agriculture". So according to the author, this topic is still being developed and discussed, especially among researchers in the social and non-scientific fields. Researchers are interested because some countries are still taboo on the use of robots.

Finally, in RQ 3, the Research with the most opportunities is design and planning in making robots on IoT in agriculture, this also happens when its application can be applied in developing countries. Also, the author will explain the summary research in Table VI.

TABLE VI. RESULT SUMMARY

| Category | Result |
|---|---|
| Main findings | This Study systematically uses PRISMA an outline of Research that is often made on Robots in IoT to increase agriculture yields. |
| Comparison with other studies | Past Research only discussed communication [42] but focused on how IoT is used with the help of robots can increase agriculture yields |
| Implication and explanation | Because, this Robot is very important in its use with the help of AI, IoT, and communication. Robots can minimize human oversight in the fields. |
| Strengths and limitations | The strength of this Research is that it offers systematic Research based on PRISMA, which is added to its RQ series, but the limitation is that it does not focus on AI in the Robot. Only focus on robots, even though AI has really contributed lately |
| Recommendation and future direction | Further research Research are to utilize more articles that not only discuss robots in smart farming but also focus on other domains |

## V. CONCLUSION

In this Study systematically, utilizing PRISMA to obtain Research systematically, the author made 3 RQs for the search results to obtain the objectives of the research review. The results in the review obtained 116 articles regarding robot research in smart farming in increasing agriculture yields. In answering RQ 1, the author gets articles by country, article type, and publication year. In RQ 2, the authors got the answer. It turns out that articles can be divided into 6 schemes, with the most being (Robot Challenges, Ethics and Opinion in Agriculture) and (Design, Planning, and System for Robot in Agriculture). Then finally, in RQ 3 the author explained the meaning related to the scheme, which existing Research explained. The author finds contributions like the factors described in RQ 3 to be Research that is often carried out for several reasons such as; AI is very important to be utilized, reapers are needed to minimize human intervention, Robot automation needs to be designed and good long-distance communication, and it is necessary to study the good use of robots in IoT to increase agriculture yield. The author understands that using robots in smart farming is very important. Suggestions for further Research and also this limitation in this Research are to utilize more articles that not only discuss robots in smart farming but also focus on other domains. Other suggestions investigate the effectiveness of different types of robots in different farming scenarios, such as small-scale versus large-scale farms or indoor versus outdoor farms. Another suggestion could be to analyze the economic and environmental impacts of implementing robots in agriculture, including factors such as cost-effectiveness, resource consumption, and carbon footprint.

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