INFOKUM
Volume 13, Number 03, 2025, DOI 10.58471/infokum.v13i03
ESSN 2722-4635 (Online)
https://infor.seaninstitute.org/index.php/infokum

Prototype Of An Automatic Control System Using Android For Iot-Based Hydroponic Cultivation

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Article Info

Keywords:
Hydroponics,
Internet of Things,
Automatic Control Systems,
and Android

ABSTRACT

This paper described develop a prototype of an automatic control system using an Android device for hydroponic cultivation based on the Internet of Things (IoT). This system is designed to monitor and control various important parameters in hydroponic cultivation, such as pH levels, temperature, humidity and nutrient availability in real-time via an Android application. Data from these sensors is sent to the cloud and can be accessed and controlled via an Android device. With this system, users can regulate environmental conditions optimally without having to be physically present, so it is hoped that they can increase efficiency and productivity in hydroponic cultivation. The trial results show that this system is able to operate well and provide a fast response to changes in environmental parameters, so it can be an effective solution for automating the hydroponic cultivation process.

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INTRODUCTION

In today's modern era, various technologies are increasingly advanced and developing rapidly, making it easier for humans to do work and help overcome problems that arise in the community environment. Technology has been applied in various types of work such as industry, military, economy, health, agriculture, and various other types of work, one of which is the field of cleanliness both at home, office, company and government agencies. In the field of knowledge and technology, it has recently developed rapidly. With advances in science and technology, new innovations have been produced that are heading in a better direction. This can be seen from large industries, automotive equipment to household electrical equipment. In the current era of globalization, we cannot be separated from development and technology. Therefore, we must be able to master technology. And compete with other countries. Currently, convenience and efficiency of time and energy are the main considerations for humans in carrying out activities. From time to time we are faced with such rapid technological developments, making human work easier. Therefore, manufacturers are trying to create an automatic plant watering system. Where in this tool the manufacturer uses a water pH sensor and Arduino Uno and NodeMCU as the main control and controller in the tool.

Figure 1. Hydroponic Framework

METHODS

This research will use the research methodexperimental to design & develop a prototype of an automatic relief machine that can facilitate and speed up the process of installing concrete fascia on houses.

1. Research Subjects/Materials
   The main materials used in this study are concrete fascia with various shapes and sizes commonly used in house construction. In addition, other materials used are mechanical and electronic components needed to build an automatic relief machine.
2. Experimental Design
   This study uses an experimental design with an iterative approach. In each iteration, the machine prototype is tested and evaluated, then improvements are made based on the results of the evaluation. This process is repeated until the resulting prototype meets the desired criteria.
3. Sampling Techniques
   Concrete fascia samples were randomly taken from various construction projects to ensure sufficient variation in machine testing. Each sample was tested using an automatic relief machine to assess its performance.
4. Measured Variables
   The variables measured in this study include the time required to form the fascia, the accuracy of the dimensions of the resulting fascia, and the success rate of installing the fascia on the building structure.
5. Data Collection Techniques
   Data were collected through direct observation and recording of the results of each experiment. Each experiment was documented with photos and videos for further analysis.
6. Data analysis

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The data were analyzed using descriptive statistical methods to evaluate the performance of the machine under various conditions. In addition, qualitative analysis was performed to identify problems and potential improvements in the machine.

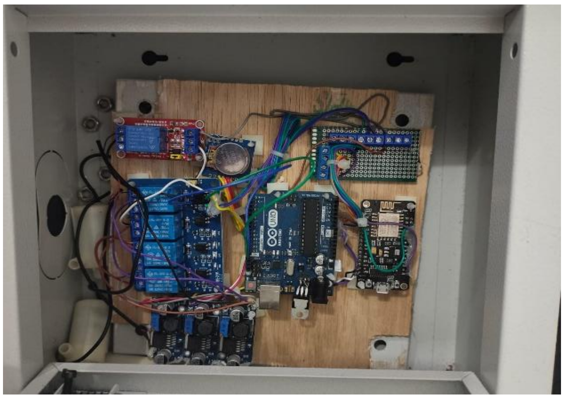

Figure 2. System schematic

RESULTS

This research has successfully developed a prototype of an automatic relief machine for installing concrete fascia on houses. This machine has been tested with various shapes and sizes of concrete fascia, and the results show that the machine is able to work well in various conditions.

1. Installation Time
   The average time required to form and install the fascia using an automatic relief machine is 15 minutes, compared to the manual method which takes about 45 minutes. This reduction in time shows a significant increase in efficiency.
2. Dimensional Accuracy
   The accuracy of the fascia dimensions produced by this machine reaches ±0.5 mm, which is in accordance with construction standards. This shows that the machine is capable of producing fascia with high precision, reducing errors that often occur in manual methods.
3. Installation Success Rate
   The success rate of installing fascia using an automatic relief machine reaches 95%, compared to 80% in the manual method. This increase shows that the machine not only improves efficiency but also the quality of installation.

After the concept of the automatic relief machine design is developed, the next stage is to test the machine that has been made. This test aims to evaluate the performance and accuracy of the machine in forming relief on the surface of the concrete fascia. Performance testing is carried out to measure and analyze the capabilities of the machine in various operational parameters. The results of the data test are collected to assess Time, accuracy, and power.

Table 1. Results of relief machine performance data

Parameter	Test Result 1	Test Results 2	Test Results 3	Average
Completion Time	05:37	05:41	05:35	05:38

Parameter	Test Result 1	Test Results 2	Test Results 3	Average
Profile Depth	±0.3 mm	±0.4 mm	±0.5 mm	±0.4 mm
Profile Dimension Accuracy	±0.5 mm	±0.8 mm	±0.7 mm	±0.7 mm
Main Motor Power	10W	12W	11W	11W
Supporting Motor Power	0.60W	0.70W	0.65W	0.65W
Battery Operating Duration	90 Minutes	85 Minutes	88 Minutes	88 Minutes
System Error	1.0%	1.5%	1.0%	1.17%

The performance test result table shows that the 1 meter relief completion time shows consistent results with an average time of 5 minutes 38 seconds. The test results vary slightly between 5 minutes 35 seconds to 5 minutes 41 seconds, indicating stable performance in the process.

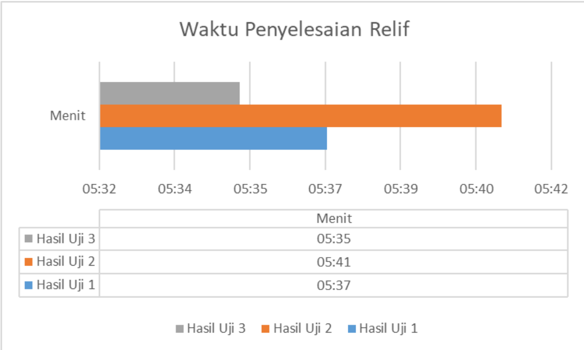

Figure 3. Graph of 1 meter rally completion time

The profile depth showed a variation of ±0.3 mm to ±0.5 mm, with an average profile depth of ±0.4 mm. This indicates that the tool is capable of producing profile depths with a relatively consistent level of accuracy, although there is slight variation between tests performed.

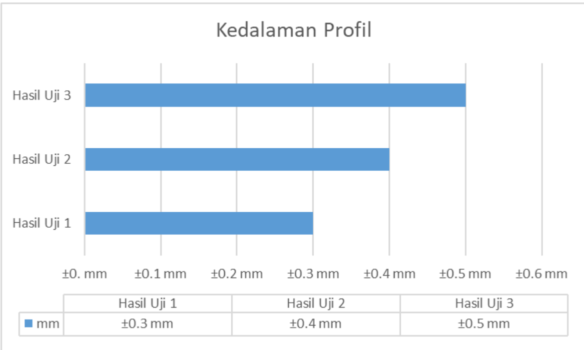

Figure 4. Profile Depth Graph

The accuracy of the profile dimensions also showed varying results, with accuracy values ranging from ±0.5 mm to ±0.8 mm and an average accuracy of ±0.7 mm. This variation indicates that there are fluctuations in the accuracy of the profile dimensions, which can be influenced by factors such as tool conditions and measurement techniques.

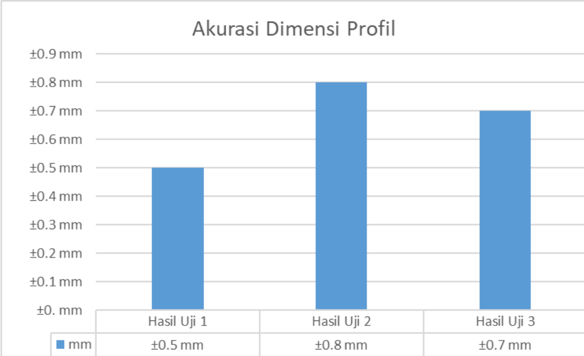

Figure 5. Profile Dimension Accuracy Graph

The power of the main motor varies between 10W and 12W, with an average power of 11W. This variation may reflect changes in load or operating conditions during the test. Meanwhile, the power of the slave motor ranges between 0.60W and 0.70W, with an average power of 0.65W. This indicates that the power of the slave motor is relatively stable but still experiences little change between tests.

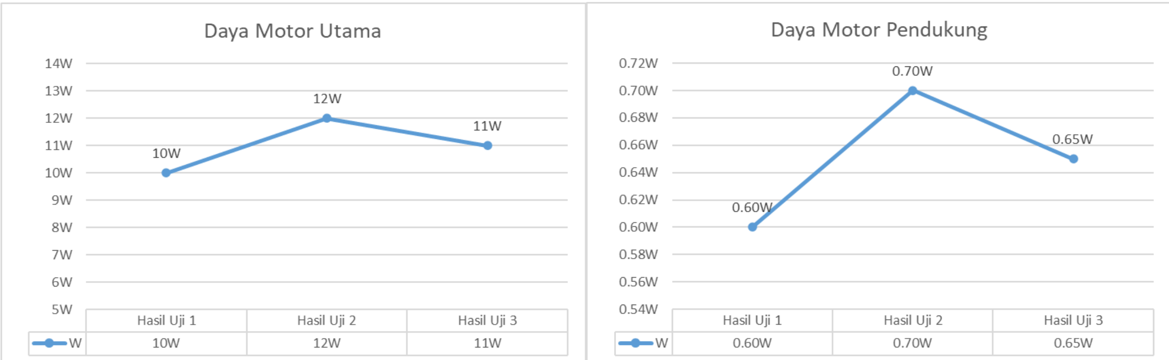

Figure 6. Main and Support Motor Power Graph

The average battery operating time was 88 minutes, with a variation between 85 minutes and 90 minutes. This shows good battery performance, although there was a slight decrease in some tests.

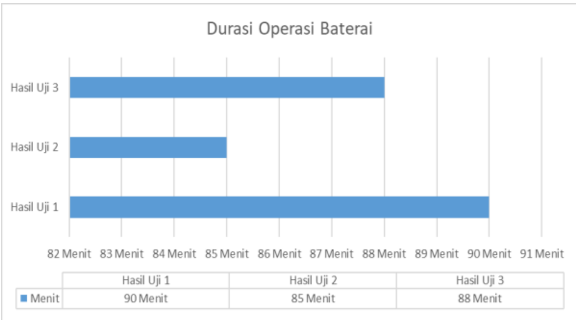

Figure 7. Battery operation duration graph

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The average system error is 1.17%, with a variation between 1.0% and 1.5%. This value indicates that the tool has a relatively low system error, but there are still some fluctuations that need to be considered in the performance evaluation.

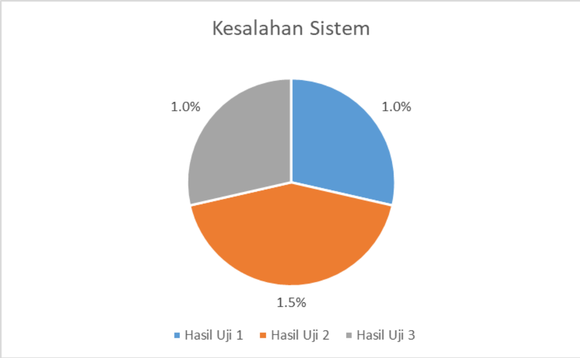

Figure 8. System error graph

Overall, the tool shows good performance with stability of finishing time, profile depth, and motor power. However, improvement in profile dimension accuracy and reduction of system errors can further improve the quality and reliability of the tool. Furthermore, a comparative test was conducted to evaluate the performance of manual method and automatic relief machine based on several important parameters such as processing time, relief shape accuracy, ease of operation, production scale capability, and operating cost. The following are the test results and comparative analysis:

Table 2. Results of comparative data on relief formation process time.

Parameter	Manual Method	Automatic Relief Machine
Processing Time		
Test 1	1:22:14	0:39:11
Test 2	1:25:03	0:40:23
Test 3	1:26:41	0:38:57
Test 4	1:23:52	0:39:45
Test 5	1:24:27	0:40:02
Average	1:24:27	0:39:40
Relief Shape Accuracy	Varies, depending on operator skill	Consistent, according to design
Ease of Operation	Requires Skills	Easy
Production Scale Capability	Limited	Tall
Operating costs	High labor costs, simple equipment	Low labor costs, machine maintenance/energy costs

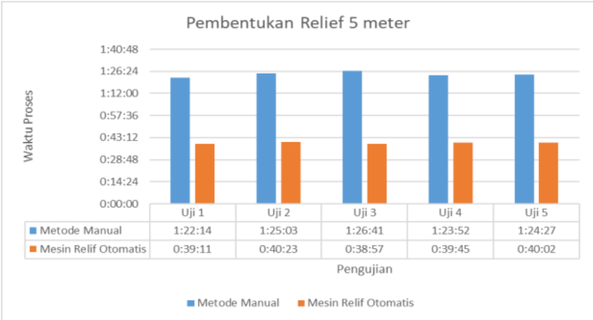

Figure 9. Process Time Comparison Chart

ResultsThis study shows that the use of automatic relief machines can increase efficiency and accuracy in installing concrete fascia on houses. The reduction in installation time by 67% is very significant, considering that time is a critical factor in construction projects. In addition, the increase in dimensional accuracy and installation success rate shows that this machine can reduce human error that often occurs in manual methods. This increase in efficiency can have a positive impact on overall construction costs. With shorter installation times, labor costs can be reduced. In addition, with higher accuracy, the risk of repairs due to installation errors can also be minimized, which will ultimately save costs.
This finding is in line with previous research showing that automation in the construction process can improve efficiency and quality of work (Smith, 2018). The use of machines in the installation of concrete fascia has also been shown to reduce worker fatigue, which can improve work safety on construction sites.

CONCLUSION

This study successfully designed and developed a prototype of an automatic relief machine for installing concrete fascia on minimalist houses. The developed machine is able to increase the efficiency of installation time by up to 67%, as well as increase the accuracy of fascia dimensions with a maximum error of ±0.5 mm. The installation success rate reached 95%, showing a significant improvement compared to the manual method. Thus, this machine not only reduces the time and effort required, but also improves the quality and consistency of concrete fascia installation. These findings confirm the great potential of applying automation technology in the construction process to improve efficiency and work quality. Further research is needed to test the reliability of this machine on a larger scale and in various environmental conditions

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