

rev1 Artikel CNAHPC

by Student_

Submission date: 08-Jun-2023 10:47AM (UTC+0300)

Submission ID: 1995309267

File name: rev1_Artikel_CNAHPC.docx (1.29M)

Word count: 3169

Character count: 16158

PCB (Printed Circuit Board) Etching Machine Using ESP32-Camera Based Internet Of Things

Adi Prasetyo¹⁾, Jamaaluddin Jamaaluddin^{2)*}, Izza Anshory³⁾

^{1*)2)3)} Electrical Engineering Study Program, University of Muhammadiyah Sidoarjo, East Java, Indonesia.

¹⁾adijoey07@gmail.com, ^{2)*}jamaaluddin@umsida.ac.id, ³⁾izzaanshory@umsida.ac.id.

ABSTRACT

PCB etching machine is a machine used to dissolve copper on a PCB board. As a solvent copper itself uses Chloride Ferrite, because it is more efficient and more commonly easy to find. For the working process of the PCB machine can be done manually or automatically. Because the modern era is fully automated, in order to minimize work is very important. This article describes about manufacturing pcb machines with Microcontroller module that has a camera feature to monitor the results of editing on a copper board. With the time method as the key to perfect results during the checking process. For as a drive, namely using a Servo Motor. The microcontroller used on this machine is ESP32 Camera based on IoT (internet of things) Telegram as a Data Base media.

Keywords: Printed Circuit Board, etching, FeCl3, Real time clock, ESP32Cam, Internet of things, Telegram

1. INTRODUCTION

In general, today's technology is made automatically. Starting from car alarm, to automatic parking. Along with technological advances that are currently developing rapidly and driven by increasing human needs (Tarantang et al. 2019). This very rapid technological development makes humans create equipment that can minimize human activities (Jamaaluddin et al. 2019). One of them is monitoring etching pcb machine through android smartphones. Now Android smartphones are in great demand from teenagers to adults, because, easy to operate and the number of applications that are easy to get. The ease of technology on this Android smartphone invites many Android application developers (Royan 2019). so Android smartphones can be used to create applications that can control and monitor the process of checking on the PCB (Printed Circuit Board).

The etching process can also be called the PCB (Printed Circuit Board) scanning process, which is the process of making paths that will connect the components on the board. PCB Etching Machine is a tool used to dissolve unneeded copper parts on a plain PCB board using a mixture of chlorid ferrite solution (Tarihoran 2019). Because ferric chloride in terms of ease to get it and very affordable price. To get good results, the PCB dissolving process must be done by heating water mixed with Ferric Chloride with a stable temperature and giving oxygen levels continuously to the solution, including what is done to give oxygen levels by shaking the PCB solvent container filled with Ferric Chloride chemical solution (Sonda and Anwar 2021).

By shaking manually from right to left using a media box and hands as tools. To develop such tools with automated systems (Pratama et al. 2021), Designing an automatic system by looking at the operator's position when carrying out the copper dissolving process of the pcb makes as comfortable as possible the operator or user (Susatyo and Bariyah 2016). This research designed an PCB Etching Machine based Internet Of Things and Monitoring Using ESP32CAM. This ESP32-CAM microcontroller is perfect for IoT projects that require camera features. The Esp32cam module has more input and output pins than the Esp32 module (Nur, Ardiyantoro, and Susandi 2022). This research uses the Internet of Things because it aims to expand internet connections that are connected in real time (Priyanto, Setiawidayat, and Rofii 2021).

To make the etching process run automatically, To make the etching process run automatically, a servo is needed (Anandya 2017). Servo motor in control with android and micro controller ESP32-Camera. This servo motor is able to work in two directions, The way this servo motor works uses a feedback system where the position of the servo motor is run as desired later it will return to the control circuit in the servo motor (Hilal and Manan 2015). The control works by shaking the PCB into the chlorid ferrite solution and then the servo functions to move it to speed up the copper dissolving process. For the copper dissolving process, temperature is also important for dissolving results

* Coresponding author



(Tarihoran 2019). The camera on the esp32cam feature serves to monitor the PCB dissolving process.

In making this PCB etching machine, several servo motors are needed as a box drive for chlorid ferrite chemical solution. for timing using RTC-DS3231 which aims to set time. Automatically, RTC is able to store all data time, day, date, month and year (Rahardjo 2021). To move the servo used a controller called a microcontroller, so that the motion system of this servo becomes automatic. To be able to monitor the checking process, this study also uses the ESP32CAM control connected to the android system to monitor the pcb checking process.

2. LITERATURE REVIEW

namely "Application of copper solvent in circuits in PCB (Printed Circuit Board)". The function of the camera feature itself is used to monitor the solution. The copper dissolution sensor is processed by raspberyy Pi and compares with manual dissolution. For the method used, color discernment is to determine the copper content. The camera test itself identifies the occurrence of color of the solution and also takes about 45 minutes to determine the results of color saturation. Saturation for data using a percentage of 20-100, which means that solutions that are less than 0.02% cannot be identified and vice versa if it is above 0.121% it also cannot (Darmono et al. n.d.).

3. METHOD

There are 3 parts to research, namely methods : Input, process, and output. In the input section there are commands from the internet of things system on telegram. In the process section there is an ESP32-CAM microcontroller. The ESP32-CAM microcontroller is used to run the Motor Servo, RTC (Real Time Clock) process and send photos to Telegram. For Output there are Photo Results displayed in Telegram when the etching process stops.

3.1 System Design

For the design system in research, the PCB etching machine tool (Printed Circuit Board) using this automatic system is divided into 3 design systems. The first system uses software design starting from the list of components and wiring. By not forgetting to connect the data pin used. The second system, the diagram block, includes the working system on the PCB etching tool (Printed Circuit Board). The third or last system, which uses flowchart design, aims to know more about the workflow of the work system from beginning to end in more detail by knowing the chart chart of the flowchart.

3.2 Wiring Design

For the display on wiring in software design, namely in figure 1 below. Where the image in each component has been connected to a microcontroller. First, For its own power source using 5v Dc. Then supplied to servo motor, esp32-cam and rtc 3231. For the data pin, the servo is connected to pin 13 on the esp32-cam microcontroller. Furthermore, for connection to the sda pin and scl rtc 3231, it is connected to pin 14 for sda, pin 15 for scl.

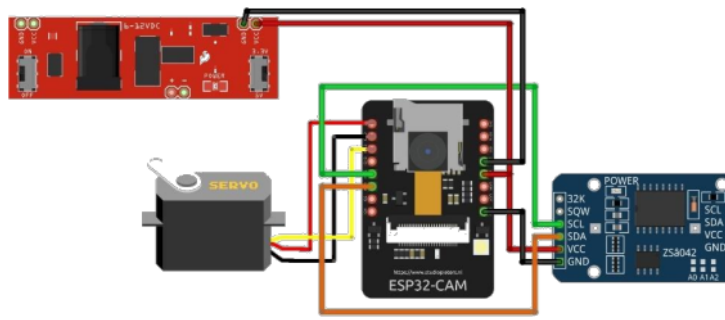


Fig. 1 Wiring Design

1
* Coresponding author



This is an Creative Commons License This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0).

Table 1
 Arduino Master Port Usage

NO	Arduino master port	Usage
1	IO 12	DATA PWM SERVO
2	IO 14	SDA RTC 3231
3	IO 15	SCL (RTC 3231
4	5V	5V VCC SERVO
5	VCC	VCC PSU VCC RTC
6	GND	GND SERVO RTC PSU

Tabel 1 menunjukkan koneksi kabel atau koneksi pin Sumber daya, Mikrokontroler Esp32-cam, Motor Servo dan Real Time Clock Ds-3231. Koneksi ke data pin perlu dicantumkan untuk tujuan merancang sistem perangkat keras menjadi lebih baik dan benar. For resources using the terminal aims to make resources a lot

3.3 Block Diagram

The system diagram block can be seen in Figure 2.

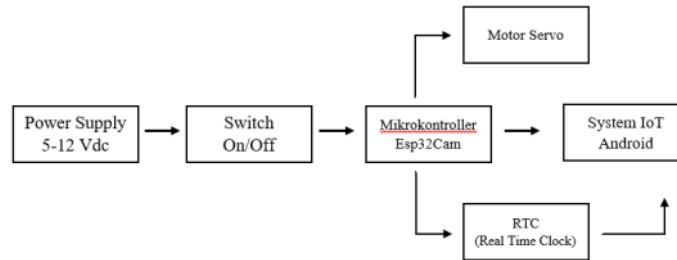


Fig.2 System Block Diagram

From figure 2 it can be explained that the hardware consists of 6 parts, starting with a power source that has a voltage value of 5 volts DC. Then it is connected to the on/off switch to be able to adjust the system on this tool if the position is off or on using the switch. Then after the switch has been connected then connected to the vcc and gnd pins on the esp32-cam. After the microcontroller is supplied, it is connected to the Real Time Clock and Servo Motor to supply the 2 modules. Don't forget to pin the data. If all wiring has been completed, then the last step is connecting to the internet of things system on Android.

* Coresponding author



This is an Creative Commons License This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0).

3.4 System Flowchart

Starting with connecting Esp32 Cam to the IoT (Internet Of Things) System, which uses the Android system on Telegram. If Yes then Esp32 cam is connected to telegram. Otherwise, it will process the connection first. If it is connected, the next process is to determine the Servo time limit which is processed using RTC (Real Time Clock). Set your own time to process how long the servo will run. When the time is determined, the servo will run and the time will also run. If the specified time is already running, the Servo will stop. After stopping the system on the Esp32 Cam will work i.e. the camera feature will send the resulting image after the time stops. Where to send the picture to the telegram system which at the beginning was already connected. Then it's done.



Fig.3 Master Flowchart Program

1
* Coresponding author



This is an Creative Commons License This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0).

3.5 Accuracy and Precision

Testing is carried out by comparing the measurement results of tools made with commonly used standard tools. In addition, testing is also carried out by taking results from actual and real-time conditions.

The calculation is carried out using several formulas, among others:

$$Deviation = (nSensor - nMeasure) \quad (1)$$

Which is the deviation formula:

$$Average Value = \mu = \frac{x_1+x_2+x_3+x_4+x_5}{n} \quad (2)$$

which is the average value formula; standard deviation formula.

$$\sigma = \sqrt{\frac{\sum_{i=1}^n (x_i - \mu)^2}{n}} \quad (3)$$

2

and formula percentage accuracy and percentage

the error can be expressed below (Yanti and Sulistiyowati 2022).

$$\%Accuracy = \left\{ 1 - \left| \frac{Y_n - X_n}{X_n} \right| \right\} \times 100\% \quad (4)$$

$$\%Error = \left\{ \left| \frac{Y_n - X_n}{X_n} \right| \right\} \times 100\% \quad (5)$$

* Coresponding author



This is an Creative Commons License This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0).

4. RESULT

2
The following is a display of the realization of the tool on the PCB Etching Machine research that has been carried out. Where in figure 4 shows the component using the number: 1. Power Supply 5 volts, 2. On/Off Switch, 3. S690 Servo Motor, 4. ESP32-CAM Microcontroller, 5. RTC DS3231 (Real Time Clock).

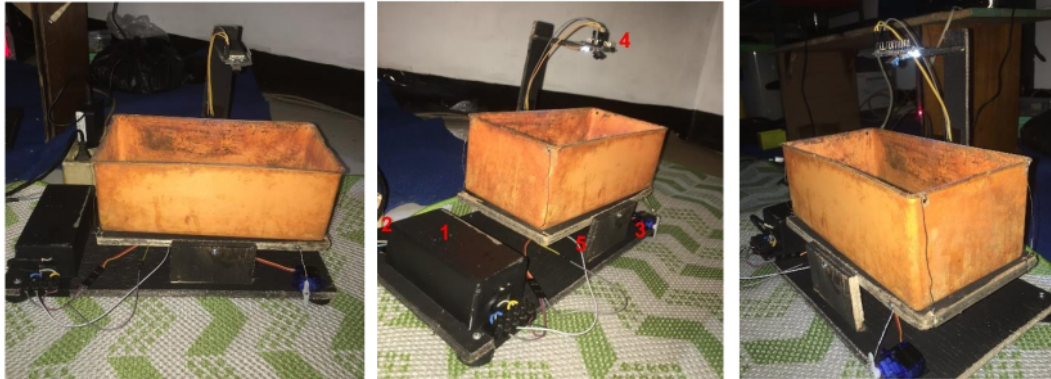


Fig. 4 Realization of tools

2
How to use this tool is as follows:

1. Connect the AC voltage to the wall outlet and then make sure the switch is on. Make sure Hotspot is on.
2. If you have a microcontroller, it will connect to the hotspot in the operator's Android notification. Marked with Servo Motor will move as notification.
3. If it is finished connecting, the next step is to check the telegram bot that has been created. Click start first on the telegram bot after that there will be a choice of time to etching. When finished the etching process, the Servo Motor will stop and will get a notification from the image delivery bot processed by the Esp32-cam microcontroller.

4.1 Power Supply Testing

For power source testing aims to measure the stabilizer voltage at the voltage of the microcontroller and other components that require power supply. results from Power Supply testing used in PCB etching tool research. Namely using the power supply used in VCDs and DVDs. Because it has amper and sufficient voltage on this PCB etching tool.

Table 2
Power Supply Testiing

Testing to-	Voltage (V)	Avometer (V)	Difference (V)	Accuracy (%)
1	5	5,08	0,8	92
2	5	5	0	100
3	5	5,07	0,7	93
4	5	5,01	0,1	99
5	5	5	0	100
Average	5	5,03	0,32	96,8

1
* Coressponding author



This is an Creative Commons License This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0).

4.2 Testing of Connection Wi-Fi Internet networks on Esp32-cam microcontroller as data communication

For testing the connection of the internet wi-fi network on the Esp32cam Microcontroller was carried out to find out how fast and how long Esp32cam can be connected to the internet network for data communication in the initial start. From the steps above, ESP32-Cam testing can be seen connected to the internet network as data communication in early starting. To be able to find out whether ESP32Cam is connected to the internet or not, then experiment by calculating the time when connecting the server 5 times.

Table 3

Testing Connection of Wi-Fi Internet ESP32-Camera

Testing to-	Hotspot Connection on Esp32 - Camera		Speed
	Condition	Waiting Time (s)	
1st Test	Connected	5	Medium
2nd test	Connected	4	Medium
3rd test	Connected	5	Medium
4th test	Connected	5	Medium
5th Test	Connected	5	Medium

4.3 Servo Motor SG90 Testing

In servo motor testing itself aims to measure the degree that will be used at the time of inspection and also at the specified time. Testing servo motors with experiments of specified degrees thus makes 5 times the experiment. Why test the degree more in the etching tool research is because what is used for the research of this etching tool uses the degree focus as an influence for the etching process. Testing starts from 0-360 degrees. If at the time of the command how many degrees will come out the same as the ordered can be said to be successful. For research, this tool uses 90° and 180° so that it can go up and down in the etching box.

Table 4

Servo Motor SG90 Testing

Testing to-	Servo Motor SG90		Description
	INPUT	OUTPUT	
1st Test	0°	0°	Success
2nd test	45°	45°	Success
3rd test	90°	90°	Success
4th test	180°	180°	Success
5th Test	360°	360°	Success

* Coresponding author



This is an Creative Commons License This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0).

4.4 ESP32-CAM Testing

Camera testing where for the last results on the etching device as soon as the servo control is stopped as well as when it also stops, the camera will access the etching results. The test was done by giving a command or giving input with the word high which means the ESP32-cam will send a photo to Telegram.

Table 5
 Esp32-Cam Checking

Testing to-	Esp32-Cam Microcontroller		Description
	Input	Output	
1 st Test	High	Potrait	Success
2 nd Test	High	Potrait	Success
3 rd Test	High	Potrait	Success
4 th Test	High	Potrait	Success
5 th Test	High	Potrait	Success

4.5 Telegram Data Testing

Table 6 shows the results of five Telegram tests with a 3-second wait time to send a notification. It can be concluded that the test results are calculated to be moderate. Because doing this telegram testing is very important to determine this tool works well.

Table 6
 Telegram Data Checking

Testing to-	Teleegram Data		Speed
	Condition	Waiting Time (s)	
1 st Test	Sending	3	Medium
2 nd Test	Sending	3	Medium
3 rd Test	Sending	3	Medium
4 th Test	Sending	3	Medium
5 th Test	Sending	3	Medium

* Coressponding author



This is an Creative Commons License This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0).

4.6 Time Testing at the Time of Sending Data from Telegram to ESP32-Cam Microcontroller

For time testing when sending data from telegram to microcontroller, it aims to know the certainty of time specified in the existing options. in testing the time at the time of sending command data from telegram to the ESP32CAM microcontroller. Where there is a command and there is a time table to determine how long to test on RTC 3231. Namely testing using 1-5 minutes. In testing the time is according to the command. Where the average engagement occurs 15 minutes.

Table 7

Testing to-	Testing Specified Time		Description
	Command Time (Minutes)	Output Time (Minutes)	
	4		
1st Test	1	1	Success
2nd test	2	2	Success
3rd test	3	3	Success
4th test	4	4	Success
5th Test	5	5	Success

4.7 Overall Testing

Overall testing can be done by bringing together hardware hardware to test how to send data whether it works, reading data and commands on the microcontroller. The overall test is done by entering commands via telegram a means of communication. The experiment was carried out 5 times if at the time of the test there were more than 3 experiments that showed ideal results eating was considered successful. If in the test shows below 3 times then it is considered unsuccessful.

Table 8
Overall Testing

Testing To-	Catu daya (v)	Waktu (Minutes)	Waktu Awal (Minutes)	Waktu akhir (Minutes)	Description
1th Test	5,08	5	19.20	19.25	Success
2nd Test	5	10	19.45	19.55	Success
3rd Test	5,07	15	20.10	20.25	Success
4thTest	5,01	20	20.40	21.00	Success
5th Test	5	25	21.10	21.35	Success

* Coresponding author



This is an Creative Commons License This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0).

5. CONCLUSION

Based on the results of research on making PCB etching machines using ESP32-Camera and the discussion described earlier, conclusions can be drawn that: (1) Etching machines that have been made can be used in the PCB Board manufacturing process. (2) PCB manufacturing is easier and efficient because the PCB manufacturing time in the etching process becomes faster. (3) Minimize work because the system used is IoT-based, which can be controlled using Android. (4) The system of this tool will turn on when the switch or switch is on and then connect the same wifi or internet if this etching tool can be used. (5) For the process of connecting the microcontroller to the data base, it requires a strong and stable signal. If there is a decrease in the internet network signal and if it is not stable, the system on the etching device does not run normally properly.

6. REFERENCES

- Anandya, Gita Rizka. 2017. "Rancang Bangun Lengan Robot Penjepit PCB 3 Dof Berbasis Arduino Untuk Proses Etching PCB Otomatis." : 110. <http://repository.its.ac.id/47867/>.
- Darmono, Hendro et al. "Impementasi Kamera Raspberry Sebagai Sensor Konsentrasi Pelarut Tembaga."
- Hilal, Ahmad, and Saiful Manan. 2015. "Pemanfaatan Motor Servo Sebagai Penggerak Cctv Untuk Melihat Alat-Alat Monitor Dan Kondisi Pasien Di Ruang Icu." *Gema Teknologi* 17(2): 95–99.
- Jamaaluddin, Jamaaluddin et al. 2019. "Sistem Kontrol Pendingin Mobil Ramah Lingkungan Berbasis Android." 2.
- Nur, Aula, Rizal Ardiyantoro, and Dony Susandi. 2022. "Pengenalan Kondisi Tanah Dengan Raspberry Pi Pada Drone Penyemprot Tanaman." *Prosiding Seminar Nasional Riset Information Science (SENARIS)* 4(2): 71–76. <https://tunasbangsa.ac.id/seminar/index.php/senaris/article/view/210>.
- Pratama, Muhammad Alip, Arnando Fajar Sidhiq, Yuri Rahmanto, and Ade Surahman. 2021. "Perancangan Sistem Kendali Alat Elektronik Rumah Tangga." *Jurnal Teknik dan Sistem Komputer* 2(1): 80–92.
- Priyanto, Agus, Sabar Setiawidayat, and Faqih Rofii. 2021. "Design and Build an IoT Based Prepaid Water Usage Monitoring System and Telegram Notifications." *JEEE-U (Journal of Electrical and Electronic Engineering-UMSIDA)* 5(2): 197–213.
- Rahardjo, Pratolo. 2021. "SISTEM PENYIRAMAN OTOMATIS MENGGUNAKAN RTC (REAL TIME CLOCK) BERBASIS MIKROKONTROLER ARDUINO MEGA 2560 PADA TANAMAN MANGGA." 8(1): 1–5.
- Royan, Ahmad. 2019. "Implikasi Binery Search Untuk Volthering Sebagai Aplikasi Data Hadits Android." *Journal of Technopreneurship and Information System (JTIS)* 2(1): 18–23.
- Sonda, Delvi, and Muhammad Anwar. 2021. "Perancangan Dan Pembuatan Alat Pelarut Pcb Secara Otomatis Menggunakan Sistem Kontrol Berbasis Mikrokontroler ATMEGA 32." *Votetknika (Vocational Teknik Elektronika dan Informatika)* 9(2): 1.
- Susatyo, Adhi, and Choirul Bariyah. 2016. "Perancangan Fasilitas Kerja Yang Ergonomis Pada Proses Pelarutan." *Jurnal Integrasi Sistem Industri* 3(1): 7–14.
- Tarantang, Jefry, Annisa Awwaliyah, Maulidia Astuti, and Meidinah Munawaroh. 2019. "Perkembangan Sistem Pembayaran Digital Pada Era Revolusi Industri 4.0 Di Indonesia." *Jurnal Al-Qardh* 4(1): 60–75.
- Tarihoran, M V. 2019. "Mesin Etching Pcb (Printed Circuit Board) Menggunakan Arduino Nano." *Seminar Nasional Ilmu Terapan (SNITER)*: 1–4. <https://ojs.widyakartika.ac.id/index.php/sniter/article/view/134>.
- Yanti, Shinta Carolin Stevi, and Indah Sulistiyowati. 2022. "An Inventory Tool for Receiving Practicum Report Based on IoT by Using ESP32-CAM and UV Sterilizer: A Case Study at Muhammadiyah University of Sidoarjo." *Journal of Electrical Technology UMY* 6(1): 49–56.

* Coresponding author



This is an Creative Commons License This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0).

rev1 Artikel CNAHPC

ORIGINALITY REPORT

19%

SIMILARITY INDEX

18%

INTERNET SOURCES

7%

PUBLICATIONS

6%

STUDENT PAPERS

PRIMARY SOURCES

1	jurnal.itscience.org Internet Source	14%
2	journal.umy.ac.id Internet Source	4%
3	repository.its.ac.id Internet Source	<1%
4	Submitted to University of Dundee Student Paper	<1%
5	ejournal.undip.ac.id Internet Source	<1%
6	journal.umg.ac.id Internet Source	<1%
7	Mochammad Hannats Hanafi Ichsan, Adven Edo Prasetya. "Fuzzy Logic and Simple Additive Weighting Implementation on River Flow Controlling System", Journal of Physics: Conference Series, 2021 Publication	<1%

Exclude quotes On

Exclude matches Off

Exclude bibliography On