ANDROID-BASED SPIN COATING MONITORING

MONITORING SPIN COATING BERBASIS ANDROID

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ABSTRACT
The spin coating technique can produce very thin layers by utilizing centrifugal force, linear shear stress and uniform evaporation of the solution on a rotating disk or substrate. The thin layer produced by the spin coating method has a high level of homogeneity. The desired thickness and quality of the coating can be controlled based on the viscosity or viscosity of the solution, material content, time, and speed of rotation of the spin coater. The research method used to develop this research is the instrumentation research method of the spin coating device which detects spin on the disc. This system uses an ESP32 Microcontroller, Hall effect Magnet Sensor, Diodes, DC Motor, LCD 165x2 i2c, Mosfet and smartphone. The results obtained are that this Spin Coating tool can rotate with a maximum speed of 3000 rpm, and a minimum speed of 1000 rpm. Although there is still noise at certain speeds caused by the less stable data transmission process and less sensitive response from the sensor, as a whole, the spin coating tool can rotate at a certain speed by monitoring using android.
Keywords: thin film, spin coating, smartphone, sensor

ABSTRAK
Teknik spin coating dapat menghasilkan lapisan yang sangat tipis dengan memanfaatkan gaya sentrifugal, tegangan geser linear (linear shear stress) *dan penguapan yang seragam dari larutan pada piringan atau* subtract *yang berputar. Lapisan tipis yang dihasilkan dengan metode spin coating memiliki tingkat kehomogenan yang cukup tinggi. Ketebalan dan kualitas lapisan yang diinginkan dapat dikontrol berdasarkan viskositas atau kekentalan larutan, kandungan material, waktu dan kecepatan putaran dari alat* spin coating. *Metode penelitian yang digunakan untuk mengembangkan penelitian ini adalah metode penelitian instrumentasi alat* spin coating *yang mendeteksi putaran pada cakram. Sistem ini menggunakan* Microcontroller ESP32, Sensor Hall Effect Magnet,

Dioda, Motor DC, LCD 165x2 i2c, Mosfet dan smartphone. *Hasil yang di dapat bahwa alat* spin coating *ini dapat berputar dengan kecepatan maksimal 3000 rpm, dan kecepatan minimal 1000 rpm, meskipun masih terdapat* noise *pada kecepatan tertentu yang disebabkan oleh proses transmisi data yang kurang stabil dan respon yang kurang sensitif dari sensor, secara keseluruhan alat* spin coating *dapat berputar dengan kecepatan tertentu dengan memantau menggunakan* smart phone android.

Kata kunci: *lapisan tipis*, spin coating, smartphone, sensor

1. INTRODUCTION

The first thin solid film was obtained through an electrolytic process in 1838. Bunsen and Grove in 1852 then obtained a metal film through a chemical reaction process and glow discharge sputtering, Faraday in 1857 then obtained a metal layer through evaporation. Thermal explosion of a metal wire carrying an electric current. The usefulness of the optical properties of metallic coatings, and the keen interest in the properties of matter in two dimensions have led to increased interest among researchers in investigating the science and technology of making these films. A thin layer is a layer of very thin material that is on a scale between nanometer to millimeter scale. In the development of its fabrication, many efforts have been made to obtain a thin layer of good quality. Thin films have many benefits in today's technological developments, especially in the material field. The thin layer is widely used as a coating material to cover the weaknesses of the coated material such as anti-corrosion, preparation of new materials before fabrication and in the development of new materials. Whereas in the world of optics, thin layers are generally used in laser technology, LEDs, and solar cells (Hudha & Sahrul, 2013). Due to its wide range of uses, several methods of growing thin films have been developed and refined by researchers to obtain good film quality. Among several methods for growing thin films are Physical Vapor Deposition (PVD) which includes evaporation, sputtering, and ion plating, Chemical Vapor Deposition (CVD) which includes Thermal CVD, Plasma-Activated CVD, photon-Activated CVD, and laser-Induced CVD. , electro-chemical deposition, deposition of emulation or paste which includes mechanical, thermal, and spray techniques as well as plating techniques which include casting techniques (spin coating and dip coating), screen printing techniques and doctor blades (Ismangil et al., 2015).

The spin coating technique can produce very thin layers by utilizing centrifugal force, linear shear stress and uniform evaporation of the solution on a rotating disk or substrate (Huda & Asrofi, 2015). The thin layer produced by the spin coating method has a high level of homogeneity. The desired thickness and quality of the coating can be controlled based on the viscosity or viscosity of the solution, material content, time, and speed of rotation of the spin coater (Muliadi, et al., 2020). Besides being easy, this technique also involves a simple process with a high success rate in producing very thin and uniform films, especially when the solution used is Newtonian (its viscosity does not change with flow rate) (Miftha & Ayu, 2017), does not evaporate too quickly and the substrate surface is smooth (Agung, 2018). When the solution used has a high viscosity or is too volatile or difficult to evaporate (Durbin & Hutagalung, 2018), the success of the spin coating process then requires the right combination of casting formulation, design, and processing conditions (Aryani, et al, 2017). This deposition technique with spin coating, in addition to offering convenience in the deposition process, also has other advantages, namely the tool can be made simply using electrical components that are quite inexpensive (Fatiyah et al., 2017).

2. METHODOLOGY

The research method used to develop this research is the hardware programming research method shown in Figure 1. The research method used includes the estimation of the components needed in the activity stages of the system manufacturing process. The components needed in designing this system are Micro Controller ESP32, LCD 12C, Dimmer 1, Channel 12V, DC Motor, Diodes, Capacitors and Smartphones. the mechanical design of the system as shown in Figure 2.

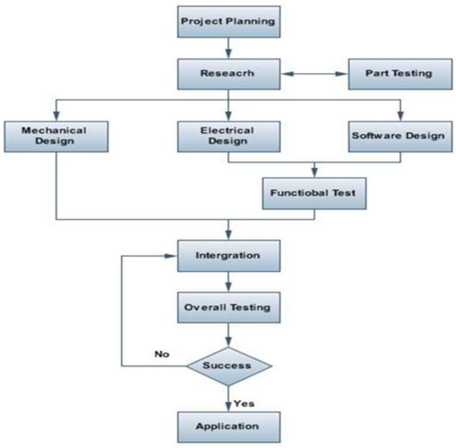

Figure 1. The research method

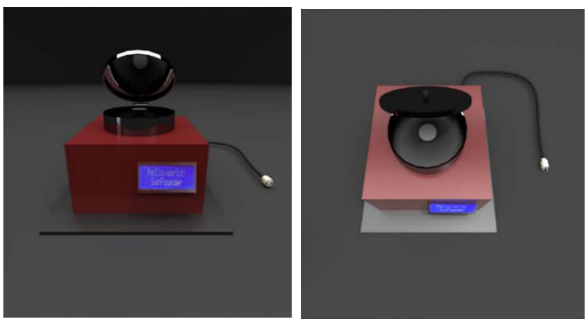

Figure 2. Front and Top Mechanical System Design

The overall system start by turning on the voltage current that is on the spin coating tool. After turning on the voltage current on the spin coating tool, all the components in the tool will work. Then the Blynk application is turned on so that the spin coating will automatically connect to the ESP32 Microcontroller. Hall Effect Magnet Sensor will detect the rotation of the disc when the spin coating is turned on. If the Hall Effect Magnet Sensor works well to read the rotation of the disc on the spin coating, then this Hall Effect Magnet Sensor will send the rpm results to the LCD and simultaneously send notifications and rpm results on the smartphone.

3. RESULTS AND DISCUSSION

The system starts to works when the initial stage receiving 12 V to execute commands. At this initial stage the system is powered by a 12 V Dimmer 1 Channel to turn on the ESP32 Microcontroller and Hall Effect sensor to detect a disc spin around the spin circle. At this stage, testing is carried out which aims to determine whether the frame lines are properly connected so that the system can function properly. The circuit lines was tested by using a multimeter. Table 1 shows the results of the structural test of the system.

Table 1. Structural Test

System components	Connect	Description
Dioda	Vin,Gnd	Connect
Motor DC	5V,Gnd	Connect
Sensor Hall effect Magnet	Gnd,Vcc,35	Connect
Lcd 165x2 i2c	Gnd,Vcc,21, 22	Connect
Mosfet	Gnd,Vcc, 26	Connect

The Hall effect magnet sensor testing is conducted by connecting the pins found on the ESP32 which aims to send backend (fair base) and frontend data to the ESP32 which will send the output to the LCD and smartphone. The Hall effect magnet sensor can detect the rotation of the rotating disc.

Figure 3. Testing the Hall effect Magnet sensor on spin coating

After several series of tests have been carried out on each of the existing components, the next stage will be an overall test on the system created. The first step is to assemble all the components, then upload the program to the ESP32 chip. As for some tests carried out on the whole system, among others:

1. The first test is to turn on the spin coating by pressing the on button on the android application on the smartphone. Here is the display of the test turning on the spin coating on the smartphone android application as shown in Figure 4.

Figure 4. Turning on the spin coating in the Android smartphone application

2. If the spin coating has been turned on in the Android application, the hall effect magnet sensor will start reading the movement of the magnet on the spinning spin coating.
3. If the magnet hall effect sensor is working with the data that has been set to be sent to the Blynk application at 3000 RPM then the ESP32 will send backend (fair base) and frontend data to the ESP32 which will send the output to the LCD and smartphones, as well as on the smartphone will also provide a notification that the tool test has been completed. Shown as Figure 5.

Figure 5. Output display

The validation stage is carried out to test the hall magnet sensor effect as system input. By detecting the rotation of the rotating disc with this test carried out 60 times, it is assumed that n = 60 times the test, can describe the optimal test results.

Table 2. Test of input voltage validation against the average value of rotational speed

No	Time (minute)	Speed (rpm)	PWM Go on	PWM Down	Notifications
1	1	2000	3000	-	finished
2	1	1500	2500	-	finished
3	1	2500	-	1000	finished
4	1	3000	-	1000	*Noise*
5	1	3000	-	2000	finished
6	1	2000	2500	-	finished
7	1	2000	-	1000	finished
8	1	1000	3000	-	*Noise*
9	1	1000	3000	-	*Noise*
10	1	2500	2000	-	finished
11	1	1500	3000	-	finished
12	1	3000	-	1000	*Noise*
13	1	2500	-	1500	finished
14	1	1000	3000	-	finished
15	1	2500	-	2000	finished
16	1	2500	-	1000	finished
17	1	2000	2500	-	finished
18	1	2000	-	1000	finished
19	1	2000	3000	-	finished
20	1	3000	-	1000	finished
21	1	3000	-	1500	*Noise*
22	1	3000	-	1000	*Noise*
23	1	1500	3000	-	finished
24	1	1500	3000	-	*Noise*
25	1	3000	-	2000	finished
26	1	3000	-	1500	finished
27	1	3000	-	1000	finished
28	1	2000	2500	-	finished
29	1	2000	-	1500	finished
30	1	2000	3000	-	finished
31	1	1000	3000	-	finished
32	1	1000	3000	-	*Noise*
33	1	2500	-	1000	finished
34	1	3000	-	2000	finished
35	1	3000	-	-	finished
No	**Time (minute)**	**Speed (rpm)**	**PWM Go on**	**PWM Down**	**Notifications**
36	1	1000	2500	-	finished
37	1	1000	3000	-	finished
38	1	3000	-	1000	*Noise*
39	1	3000	-	1000	finished
40	1	2000	2500	-	finished
41	1	3000	-	2000	finished
42	1	2500	-	2000	finished
43	1	3000	-	1500	finished
44	1	1500	3000	-	finished
45	1	1500	2000	-	finished
46	1	3000	-	1000	finished
47	1	3000	-	1000	finished
48	1	2500	-	2000	finished
49	1	1000	2500	-	finished
50	1	1000	3000	-	finished
51	1	2000	-	1500	*Noise*
52	1	2000	3000	-	finished

53	1	1500	2500	-	*Noise*
54	1	2500	-	1500	finished
55	1	1000	2500	-	finished
56	1	1000	3000	-	finished
57	1	1000	3000	-	*Noise*
58	1	3000	-	1500	finished
59	1	3000	-	1500	finished
60	1	2000	-	1000	finished

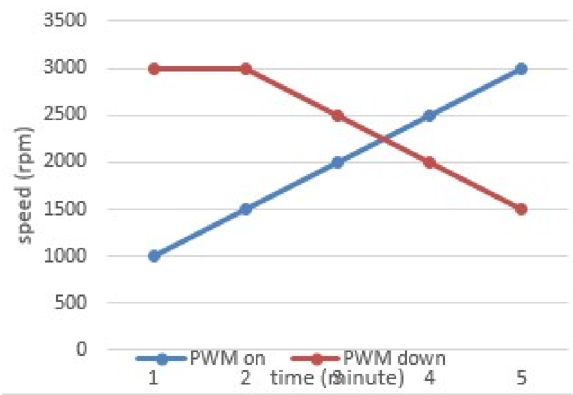

Figure 6. Test of input voltage validation against the average value of rotational speed

This experiment was carried out 60 times, divided into two parts, the first used the PWM Value Up, while the second used the PWM Value Down and there were 12 different data obtained. Because the result is noise due to an error in the system, it may stem from the data transmission process or the less stable response of the Hall Effect Sensor in adjusting the speed increase or decrease when the entire system is operational.

4. CONCLUSION

Based on the results of the study, it can be concluded that the Spin Coating tool can rotate at a maximum speed of 3000 rpm and a minimum speed of 1000 rpm. However, there is still noise at certain speeds, particularly at 3000 rpm, caused by an unstable data transmission process and a less sensitive sensor response when approaching rotation. Overall, the spin coating tool can operate at specific speeds with monitoring using an Android device.

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