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Manufacturing Animal Infusion Fluid Control And Monitoring Tools As Health Facilities At The Animal Polyclinic Of IPB Vocational School

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Abstract – Making a device for monitoring infusion fluids in animals serves to create a drip-based infusion control device Node MCU ESP32 on infusion equipment. This tool is equipped with sensors photodiode which functions to detect droplets of infusion fluid. The results of monitoring and reading infusion drops will later be entered on the website which can be accessed via desktop or mobile. If the infusion drops are in accordance with the predetermined amount, then buzzer will be sound as a reminder. The tool that will be created is IoT based which can connect with the website. The function of the website is to regulate the number of infusion drops and record the data later converted in the form of an excel file. The automation tools that will be created can be accessed remotely via desktop or mobile computers. This IV fluid automation tool can be applied to pets such as cats and dogs. The dose of intravenous fluid given to animals is adjusted to the animal's needs based on recommendations from the veterinarian. There are two important components in this tool, namely the upper part to regulate the transfer of the infusion based on load and the lower part to regulate the number of infusion drops given.

Keywords – Monitoring tools, Photodiode sensors, websites, IoT, infusion fluid dosage, infusion transfer, number of droplets

I. INTRODUCTION

Infusions are generally used in treatment in hospitals or other health facilities to provide necessary fluids, medicine, or nutrition to patients [1]. Infusion devices are designed to make it easier to administer drugs or fluids directly into the patient's body at the correct dose, as well as allowing accurate monitoring by medical personnel [2]. Monitoring infusion administration to animals in the clinic is very important because it is part of medical therapy. In general, monitoring of infusion installation is still done manually by nurses and paramedics who must check the infusion fluid in the patient's room intensively. If there is a problem, such as a clogged IV or running out of IV fluids, this can have a negative impact on the patient. Loss of body fluids can occur normally through breathing, skin, feces and urine. Abnormal fluid loss through vomiting and diarrhea.

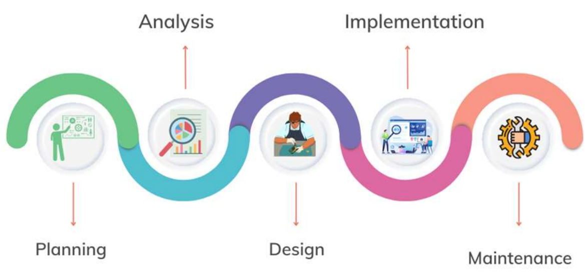
Fluid therapy is an important treatment measure for patients, such as animals in critical condition or requiring intensive care [3]. The main goal of fluid therapy is to treat dehydration, restore circulating blood volume in hypovolemia or shock, restore and maintain electrolytes (Na+ and K+), and acid bases in the body to normal limits. [4]. The normal need for body fluids in dogs and cats to replace fluids lost through the urinary, respiratory, skin and feces systems is 40–60 ml/kg/day. Replace all body fluids lost at least 70-80% within 24 hours or quickly replace half of the fluids lost during the first 4-8 hours.

Each nurse will replace the patient's IV fluids, if the fluids run out. Often the patient's infusion runs out, the IV fluid has not been replaced, because the number of nurses and patients is not balanced in monitoring the patient for 24 hours. Sometimes patients have to press a button to call the nurse to provide information about changing the IV. [5]. A paramedic monitors the use of infusion fluids so that there is no excessive fluid administration to patients. This must be done routinely by a nurse, where the nurse must continuously check the condition of the patient's infusion one by one. [6]. Efforts have been made to implement technology in both outpatient and hospice care for pets. Internet of Things (IoT) is a concept where inanimate objects have the ability to receive and transmit data over network connections. The Internet of Things is one technological advancement that can be used to benefit patients and provide them with high-quality care. This progress is also useful for making the work of nurses easier so that the desired results can be achieved, both to increase patient satisfaction and to maintain patient safety [7]. IoT is used to collect raw data in real time in an efficient manner [8]. Based on this, a tool will be created to facilitate the administration of infusion fluids which makes it easier for the process of controlling infusion fluids and monitoring infusion fluids. The tool is named "INTARA".

The control and monitoring tool called "INTARA" is an abbreviation of the words in which means "infusion" and "tara" which comes from Sanskrit which means animal. The way the tool works is that it is integrated with a website where there is a feature to regulate the infusion fluid that will be given to the animal. Giving fluids to animals will of course be adjusted based on the veterinarian's recommendations. The developed system eliminates the need for nurses to continuously monitor IV fluids and is easy to access and cheap enough to use in hospitals that cannot afford more expensive equipment. [9].

In designing tools, electronic components are needed as input and output. According to [10]A load cell sensor is a sensor designed to measure loads using the pressure principle, which means that during the weighing process it will cause a metal reaction in the load cell which produces an elastic force. . LCD (liquid crystal display) is an electronic component that functions to display numbers, letters or other symbols by emitting light from the backlight, depending on the specifications for the number of characters the LCD has. [11]. ESP32 is an SoC microcontroller that uses a 32-bit microprocessor, has 18 ADC pins (12-bit), four SPI, and two I2C, and has a Bluetooth adapter for wireless communication and Wifi for accessing the internet network. [12]. The WiFi module functions as a communication medium between the web server and the ESP32 controller for the process of sending captured data when movement is indicated in the room. [13].A buzzer or alarm is a device that can make a loud sound which functions as a warning [14]. According to [15], a servo motor is a motor that is capable of working in two directions (CW and CCW) with a deflection at each angle reaching 90° so that the total deflection angle from right to center to left is 180°, which means the direction and angle of rotor movement can be controlled simply by sets the duty cycle of the PWM signal on the control pin. A photodiode sensor is a type of light-sensitive diode that, when exposed to light sent by an LED emitter, changes its resistance [16].

II. METHOD



This research uses the SDLC (Systems Development Life Cycle) methodology in systems engineering and software engineering, namely the process of creating models used to develop systems. The system design stages consist of five processes, namely planning, analysis, design, implementation, testing and management. The planning stages carried out in this research were through joint discussions with partners. In this process, researchers determine solutions to problems experienced by partners [11].

Next, the analysis process was carried out with a location survey at the veterinary polyclinic. Then analyze the shape of the tool according to the location and the function of the tool according to the data in the polyclinic. After carrying out the analysis, researchers can design tools and implement IoT based on the survey results and data that have been obtained.

III. DISCUSSION

The first stage in making a tool is designing the tool. Tool design stagesThis is done by creating a flowchart to simplify the performance steps of the tool. The following are the stages of the tool's working process in both parts, namely the upper circuit and the lower circuit.

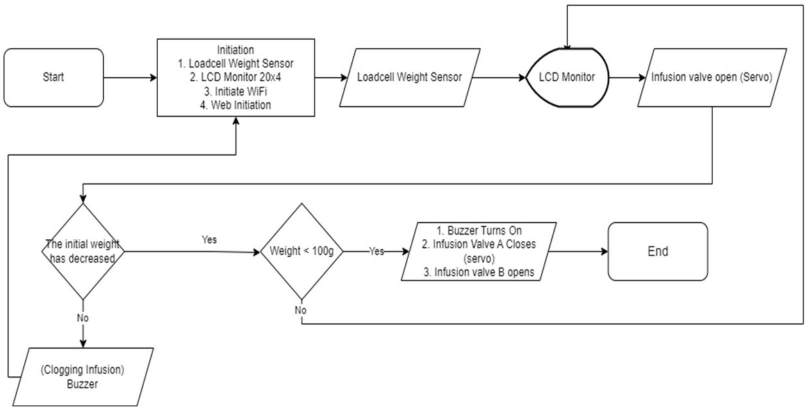


Figure 2 Upper circuit flow diagram

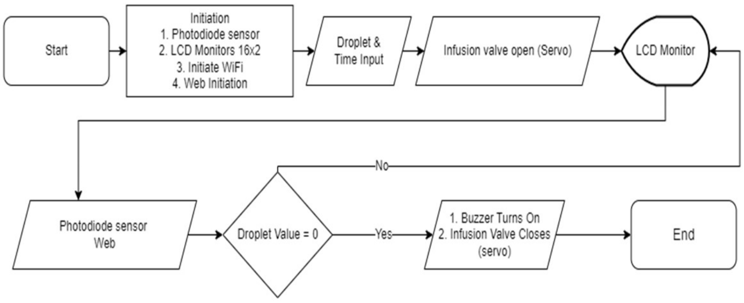


Figure 3 Flow diagram of the lower circuit

There are two flowcharts created, namely flowcharts forThe upper circuit functions to transfer the infusion when the animal is to be given more than 100 grams of infusion fluid and the lower circuit flowchart functions to regulate the number of drops given. The fluids that will be given to animals are based on recommendations from the veterinarian. If more than 100 grams of fluid must be given, the upper circuit will be used. The upper circuit consists of ESP32 electronic components, 20x4 I2C LCD, buzzer, HX711 Load Cell sensor, and GR996 servo motor. The working process of the above circuit can be seen from the flowchart stages based on Figure 2. The flowchart process starts from tool initiation starting from load sensor initialization, LCD monitor initialization, WiFi initialization and website initialization. [17]The servo then opens the infusion hose to be used, then the load sensor will continue to read the load from the infusion being used. When the load sensor reads that the IV fluid used is less than 100 grams, the servo on the IV used will close the IV tube. The servo on the backup IV tube will open, then the backup IV will replace the role of the main IV to provide IV fluids until the fluid given is in accordance with the veterinarian's recommendations. The lower circuit consists of ESP-32 electronic components, photodiode sensor, I2C LCD 16x2, and servo motor. The working process of the lower circuit is based on the number of droplets given. In the flowchart in Figure 3, starting from initializing the tool as in the series above. We enter the amount of fluid to be given to the animal according to the veterinarian's recommendations. For example, if we enter 10 droplets on the website, then the LCD of the device will display a number of 10 droplets. The calculation reading by the microcontroller is in the form of high-low logic according to Photodioda [18]. The tool will work and emit 10 droplets according to what is input on the website.

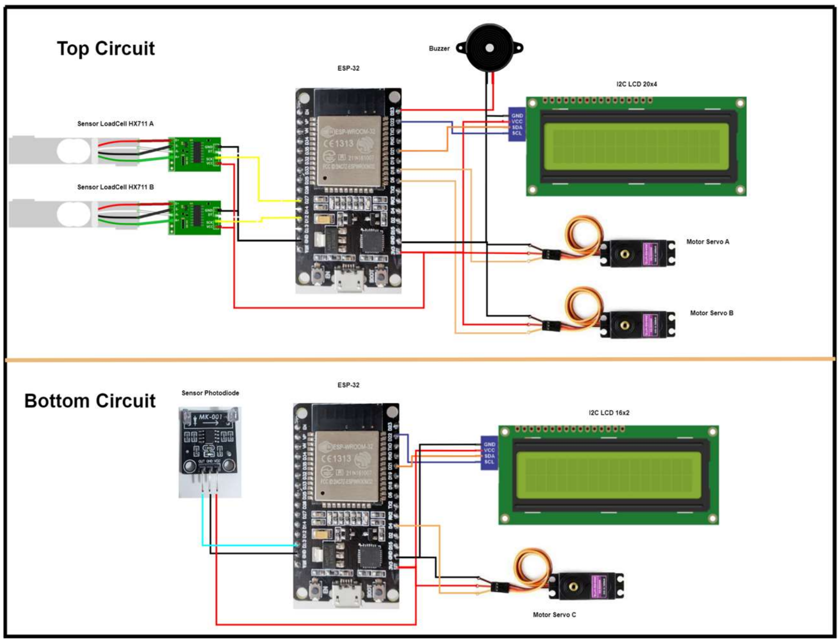


Figure 4 INTARA circuit schematic

The INTARA circuit schematic as in Figure 4 consists of two circuits which are used to define the components used and their cable management. This circuit schematic is very important to create as a guide to the requirements for the components used as well as a guide in making the circuit. Top Circuit is a circuit scheme for a loadcell or infusion load meter, there are two loadcells used, namely to measure infusion load A and infusion load B. ESP 32 as a microcontroller, buzzer as an alarm, servo to transfer the use of infusion A to B or vice versa and The LCD is used to output monitoring data for Infusion A load and Infusion B load. Bottom Circuit is a circuit scheme that contains a photodiode as a droplet counter, ESP32 as a microcontroller,

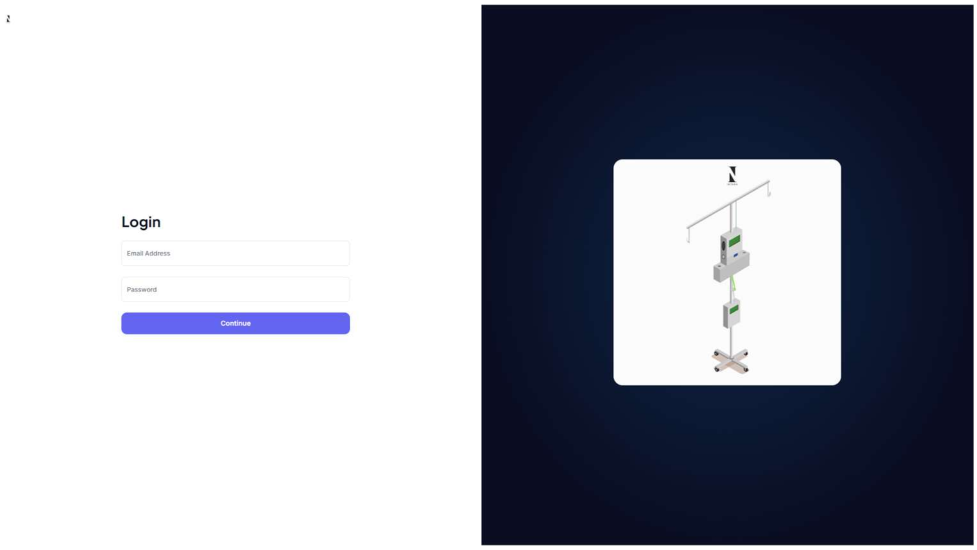


Figure 5 Display of the IoT website login menu

The INTARA website uses an email and password authentication system to enter the website as in Figure 6. Authentication is carried out using Firebase in real-time to ensure the security and reliability of the infusion data integration process [19]. Users can log in using an account that has been registered on the Firebase system. Firebase data is a Cloud Computing system that is integrated into the internet, then the ESP32 functions as a microcontroller that processes incoming data from input, namely from Firebase. [20]

RESULTS OF TRIAL DATA CALCULATION OF THE NUMBER OF DROPS			
10 Drops	20 Drops	30 Drops	50 Drops
0	0	0	0
1	1	1	1
3	3	3	4
5	5	5	5
7	7	7	6
9	9	9	7
	11	13	8
	13	15	9
	15	15	10
	18	15	11
		18	11
		22	12
		24	13
		27	16
			19
			21
			24
			26
			28
			31
			33
			35
			37
			39
			43
			45
			46
			48

Figure 6 Results of Drip Testing on the Website

The first test was carried out for the bottom circuit, namely counting the number of droplets. The test was carried out 4 times with the droplet values, namely 10 droplets, 20 droplets, 30 droplets and 50 droplets as in Figure 6. Initially the sensor reads the number of droplets from zero and will count according to the number of droplets configured on the website. The more input droplets, the more data generated. In the testing process, the reading of the droplet values on the website is not real time, meaning that the number of droplets does not match the numerical sequence because there is a delay from the droplet reader sensor to the microcontroller.

The second test was carried out for the upper circuit, namely testing the infusion displacement based on load. The test is carried out to see the displacement of the infusion when the load read for the main infusion is less than 100 grams. The second test is also related to the number of droplets released. The test was carried out twice, namely 230 droplets and 400 droplets and there were load A and Load B as in Figure 7. The green color shows data on the droplets emitted by load B before moving the infusion to load A. The yellow color shows the transfer of infusion from infusion B to infusion A after load B is less than 100 grams. After the transfer, infusion B still reads as having a decrease in load because it is affected by the slope caused by the load on infusion A being greater than the load on infusion B. One of the inaccuracies in reading the data is displaying data values of 0,

RESULTS OF INFUSION TRANSFER TRIALS & DROPLETS CALCULATIONS					
230 Drops			400 Drops		
WEIGHT A	WEIGHT B	TOTAL DROPS	WEIGHT A	WEIGHT B	TOTAL DROPS
154,08	135,69	0	585,84	142,85	0
154,17	135,7	2	585,92	142,85	0
154,25	135,69	2	585,77	142,84	1
154,32	135,69	2	....	....	....
154,33	135,62	3	577,49	116,23	228
154,23	135,47	7	577,49	116,23	232
154,12	135,05	11	580,2	115,49	236
154,11	134,93	15	583,94	114,46	240
154,1	134,59	19	584,89	114,21	244
153,93	133,72	23	587,89	113,69	248
153,79	133,03	27	589,52	113,41	252
153,85	132,02	31	0	113,14	256
153,83	131,28	35	591,68	112,86	260
153,76	130,29	39	592,87	112,54	264
153,73	129,78	43	595,12	111,59	268
153,69	128,68	47	595,56	111,33	272
153,63	128,11	51	595,99	111,05	276
153,5	126,94	55	596,92	110,16	280
153,46	126,4	59	597,54	109,55	283
153,38	125,32	63	598,03	108,42	287
153,33	124,85	67	598,6	107,54	291
153,26	123,9	71	598,59	107,27	295
153,27	123,69	75	599,13	106,78	299
153,26	123,23	79	599,47	106,2	303
153,23	122,68	83	599,53	105,81	305
153,22	122,37	87	600,33	105,51	307
153,18	121,7	91	600,47	105,03	309
153,05	120,22	95	600,47	104,72	309
152,94	118,84	99	600,75	104,31	311
152,89	118,17	103	600,96	103,77	312
152,87	117,57	107	600,64	103,65	314
152,87	116,97	111	601,01	103,23	318
152,89	116,68	115	601,86	102,61	320
152,88	116,41	119	602,34	102,1	324
152,9	114,9	123	602,6	101,83	328
152,92	114,49	127	602,86	101,52	332
152,95	113,23	131	602,92	101,34	336
152,97	112,34	135	603,01	100,97	340
152,98	111,45	139	603,07	100,78	344
153	110,54	143	603,07	100,78	345
153	110,12	147	603,32	100,56	345
152,99	109,68	151	604,24	99,8	345
0	0	155	604,91	99,25	347
153,19	102,59	175	605,51	98,159	351
153,11	102,18	179	605,89	97,28	355
153,11	102,18	183	605,82	96,95	358
0	0	187	605,82	96,95	362
153,1	101,88	195	604,92	96,76	366
153,24	100,12	199	603,2	96,59	368
153,46	98,9	203	601,91	96,6	372
153,72	98,05	204	600,94	96,59	376
154,11	96,43	207	600,38	96,56	380
154,18	95,76	211	599,77	96,59	383
153,98	95,24	215	599,16	96,55	386
153,72	95,1	219	598,42	96,54	390
153,63	95,04	223	597,51	96,54	394
153,43	94,95	227	596,85	96,53	398

Figure 9 Test results for infusion tube displacement based on load

IV. CONCLUSION

An infusion fluid monitoring tool has been successfully created. This tool is an infusion device that is integrated with Internet of Things (IoT) technology and can be configured for the number of drops via the website. The purpose of making the tool is to facilitate the work of paramedics in giving intravenous fluids to animals such as dogs and cats. This tool is designed to have two main circuits. The first circuit is the upper circuit to regulate the transfer of the infusion load from one infusion to another using a load sensor, the second circuit is the lower circuit to regulate the number of droplets to be released. The development of an IV fluid monitoring tool or INTARA is expected to provide convenience and accuracy in administering intravenous fluids to pets, increase efficiency,

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REFERENCE

[1] A. Hindersmann, "Kebingungan tentang infus: Tinjauan proses infus. Komposit Bagian A: Sains Terapan dan Manufaktur," *Applied Science and Manufacturing,* vol. 126, 2019.

[2] R. Sulaiman, Z. Azhar and T. Christy, "Perancangan Sistem Alat Pemantauan Cairan Infus Pada Klinik Utama Tanjung Balai Berbasis Nodemcu," *JUTSI (Jurnal Teknologi dan Sistem Informasi),* vol. 1, no. 3, pp. 211-218, 2021.

[3] L. Limjo, "Kajian Terapi Cairan Pada Pasien Anjing Di Rumah Sakit Hewan Prof. Soeparwi Fakultas Kedokteran Hewan Universitas Gadjah Mada Periode November 2020-Oktober 2021," Universitas Gadjah Mada, Jogjakarta, 2022.

[4] T. Z and S. HN, "POLA PENGGUNAAN OBAT PERKEMIHAN SISKITIS PADA RAWAT INAP KUCING DI MAKASSAR PET CLINIC PADA TAHUN 2021," *Jurnal Kesehatan Yamasi Makassar,* vol. 7, no. 1, pp. 28-38, 2023.

[5] G. Priyandoko, D. Siswanto and I. I. Kurniawan, "Rancang Bangun Sistem Portable Monitoring Infus Berbasis Internet of Things," *Jambura Journal of Electrical and Electronics Engineering,* pp. 56-61, 2021.

[6] B. Wijayanto, A. Hermawan and L. Marlinda, "Automated Infusion Monitoring Device Using Arduino-Based IoT (Internet of Things)," *Journal of Computer Networks, Architecture and High Performance Computing,* vol. 5, no. 2, pp. 590-598, 2023.

[7] H. A. Ajiyanti and L. O. A. Rahman, "Internet of Things for Monitoring Infusion Fluids in Intravenous," *Indonesian Journal of Sport Management and Physical Education (IJSMPE),* vol. 1, no. 2, pp. 49-58, 22.

[8] S. Narulita, M. Syafaat and W. F. Safari, "Design, Assembly and Testing of Infusion Monitoring System Based on Internet of Things," in *Atlantis Press*, Jakarta, 2023.

[9] N. Y. S. KEERTHI, A. RAJU, N. SOWMYA and D. B. KRISHNA, "INTRAVENOUS INFUSION MONITORING SYSTEM," *International Journal For Recent Developments in Science & Technology,* vol. 4, no. 3, pp. 37-42, 2020.

[10] L. AH and S. A, "Rancang Bangun Pintu Wahana Otomatis Menggunakan Sensor Ultrasonik Hc-Sr04 Sebagai Pengukur Tinggi Badan Dan Sensor Load Cell Dengan Hx711 Sebagai Pengukur Berat Badan Berbasis Arduino Mega 2560," *Gema Teknologi,* vol. 19, no. 2, pp. 15-18, 2017.

[11] A. AK and H. Si, "Sistem Pengaturan Beban Generator Satu Fasa Secara Otomatis Berbasis Arduino Uno," *Jurnal Teknik Elektro,* vol. 9, no. 2, 2020.

[12] S. H. and A. Gm , "TUGAS AKHIR: MONITOR BIAYA LISTRIK BERBASIS IOT (Internet Of Things)," *POLITEKNIK NEGERI CILACAP,* 2022.

[13] R. A, "Prosiding Lokakarya Riset Industri dan Seminar Nasional Bandung ke -12," no. 2021.

[14] A. M. , S. S and U. Gp, "Monitoring Ruangan Jarak Jauh Menggunakan Mikrokontroler Dfrduino , Sensor Passive Infrared dan Buzzer,," *Prosiding SISFOTEK ,* vol. 1, no. 1, pp. 143-152, 2017.

[15] H. A and M. S, "Pemanfaatan Motor Servo Sebagai Penggerak Cctv Untuk Melihat Alat-Alat Monitor Dan Kondisi Pasien Di Ruang Icu," *Gema Teknologi,* vol. 17, no. 2, 2015.

[16] S. M, R. F and Q. A, "Rancang Bangun Tempat Pemantauan Sistem Sampah Rumah Tangga Dan Penerangan Jalan Berbasis Jaringan Sensor Nirkabel (Wsn)," *Transmisi,* vol. 20, no. 4, pp. 158-166, 2019.

[17] R. A. Candra, D. S. Saputra, D. N. Ilham, H. Setiawan and H. Hardisal, "The Infusion of Notification Design With an Application of Social Media Based on a Internet of Things (IOT)," *Sinkron Jurnal & Penelitian Teknik Informatika,* vol. 5, no. 1, pp. 129-137, 2020.

[18] A. G. K. Juje, A. Ramadhan and S. Muharom, "Design and Build a Telegram – Based Infusion Droplet Control and Monitoring System," *Procedia of Engineering and life science,* vol. 2, no. 2, 2022.

[19] L. Zhang, "Design and Research of Infusion Monitoring System Based on OneNET Platform," *IOP Conference Series: Earth and Environmental Science,* pp. 1-4, 2020.

[20] S. Sumardi, S. Mulyati and M. C. Maisandi, "Rancang Bangun Alat Pengisian Air Botol Minuman Berbasis IoT Menggunakan NodeMCU ESP32 Dengan Firebase Google," *Jurnal Teknik Elektro UMT,* vol. 6, no. 1, 2022.