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Simulation of Enhanced Controlled Automatic Hand Drayer with Temperature Display

Alaa Hussein Ali Al-Obaidi

Assistant lecturer, Babylon university-College of Fine Arts, Iraq

Abstract

In the ongoing current life, especially in medical clinics, individuals ordinarily use fabric or tissue to dry their hands. It shows up less viable, successful and sound. Furthermore, a few cafés still use fabric or tissue for hand cleaning and drying. To defeat this issue, a few medical clinics and eateries have given hand dryers. It can dry hands yet can't dispense with germs or microbes. It is important to make a hand dryer furnished with a sterilizer. This exploration, thusly, made a hand dryer that can all the while dry and clean hands that worked naturally utilizing the MatLab17b Simulator. The device was planned by utilizing warmth and movement reproduced sensor to distinguish hands with the show. This method has been applied with the assistance of MatLab17b Tool Box to peruse and process the sensors to actuate this movement and temperature warming. The outcomes found that the device furnished with temperature and warming showcase can dry hands just as killing microscopic organisms and germs.

Key Words: Hand Dryer, Automatic, Temperature Display, Heating Sensors, Motion Sensors

الخلاصة

في الحياة الحديثة ، وخاصة في المستشفيات، يستخدم الناس عادة القماش أو الأنسجة لتجفيف أيديهم. ويبدو أقل عملية وفعالة وصحية. بالإضافة إلى ذلك، لا تزال بعض المطاعم تستخدم القماش أو الأنسجة لتنظيف اليدين وتجفيفها. وللتغلب على هذه المشكلة، وفرت عدة مستشفيات ومطاعم مجففات لليدين. يمكن أن تجف اليدين ولكن لا يمكن القضاء على الجراثيم أو البكتيريا. فمن الضروري لإنشاء مجفف اليد مجهزة معقم. هذا البحث ، لذلك ، خلق مجفف اليد التي يمكن أن تجف في وقت واحد وتعقيم اليدين التي عملت تلقائيا باستخدام برنامج المحاكاة الواقعية MatLab17b. لقد تم تصميم هذه الأداة باستخدام الحرارة والحركة ومحاكاة الاستشعار للكشف عن اليدين مع توفير شاشة للعرض. وقد تم تطبيق هذه التقنية بمساعدة من MatLab17b ومن خلال صندوق الأدوات المدعوم لقراءة ومعالجة أجهزة الاستشعار لتنشيط هذه الحركة ودرجة الحرارة للتدفئة. ووجدت النتائج أن الأداة المجهزة بمقياس درجة الحرارة وشاشة التدفئة يمكن أن تجفف اليدين بالإضافة إلى القضاء على البكتيريا والجراثيم.

1. Introduction

Individuals for the most part, use material or towels to clean their hands. It's less viable, viable and sterile. Cleanliness isn't kept up on the grounds that the material is regularly tainted with the hands of numerous others. The hand towel gets messy effectively with the goal that we frequently need to clean it. Since it is frequently washed away, it gets feeble and effectively harmed. To defeat this issue, a hand dryer outfitted with a temperature control was made. A few scientists have directed examinations controlling the temperature. Lin considered observing and control frameworks for brilliant plant development conditions. The framework comprised of a photon transition thickness sensor, a microcontroller, and an actuator comprising of blowers, warmers, exhaust fans, and liquid radiators. [1]. Chen analyzed a canny temperature control framework dependent on trans cranial miniaturized scale current sorrow treatment instrument. The framework comprised of a temperature sensor utilizing Pt100 which is embedded into the sign processor, an AT89S51 type microcontroller and a warmer [2]. Mandala, Sumaryo, and Estananto researched Nursery of savvy brilliant fish eggs with a microcontroller. The framework utilized four sensors comprising of temperature sensors utilizing LM35, stickiness sensors utilizing ds18b20, nearness sensors utilizing ultrasonic sensors and PH sensors. The sensor was prepared utilizing an Arduino mega2560 microcontroller [3]. Rego Segundo, Cocoa, and Ferreira built up an instructive apparatus for control building. The device comprised of a PIC18F4550 microcontroller, a smaller than normal cooler, a resistor, a LM35 temperature sensor, a fluid gem show, a USB connector, a semiconductor, a LED, a potentiometer, a resistor, and a capacitor [4]. Polyakov considered advanced temperature meter polyethylene protection. The framework comprises of bright radiation, temperature and mugginess sensors, ATMEGA16 microcontroller [5]. Yingying read control framework for natural cooling. The framework comprises of temperature and moistness sensors, microcontroller and forced air systems [6].

A programmed observing and control framework inside the nursery was examined by Hassan. The framework comprised of a light sensor, temperature and stickiness sensors, an Arduino microcontroller, a fumes fan, a water warmer and a water siphon [7]. Pawlenka and Skuta built up a microcontroller-based security framework. The framework comprised of three sensors comprising of gas sensors, mugginess sensors and temperature sensors, an Arduino microcontroller and a web application [8]. LITA inspected temperature control framework for quickened maturing tests on printed circuit sheets. The framework comprises of a temperature sensor, a warmth sensor, a microcontroller PIC16F877, and the web [9]. Sanjaya directed exploration on keen quail hatcheries for bring forth frameworks dependent on microcontrollers and the web of things (IoT). The framework comprised of temperature and dampness sensors, an Arduino microcontroller, light radiators and warmers [10]. Dhole and More considered installed ethernet microcontroller model for checking and control various boundaries. This framework utilized two simple temperature channels, to be specific stickiness sensor channel and optical sensor channel, associated with 8 light-emanating diodes to get high and low signs for every application at the same time [11]. Ili Flores explored concurrent control of moistness and temperature rationale in neonatal hatcheries. The sensor comprised of temperature and mugginess sensors, an ARM cortex microcontroller, and a warmer [12].

To understand these inadequacies and to be progressively useful, there are currently a few instruments that can rapidly dry hands called hand dryers. This hand drying technique is regularly utilized in bistros, inns, and medical clinics. Basically, the working standard of hand drying will be drying with dry air overwhelmed by a drying machine. The structured hand dryer machine utilizes movement and warmth sensors with temperature show. The expansion of the temperature show can improve hand washing process through watching the transmitted warmth from the dryer. The motor and show will work when the movement sensor identifies the nearness of a hand (object) blocking it and quits working when the item is leaving.

This venture research work bargains on the structure and execution of a programmed hand-dryer with show equipped for evaporating a wet hand embedded under its vent and goes off naturally when the ends are expelled. The framework additionally consolidates a decimal checking unit that shows the temperature of the extinguished air at 0 C^0 temperature. This framework is designed utilizing movement sensors put at the data. The yield of the sensor is adapted by quad-2-input Schmitt trigger NAND entryway which fills in as the control rationale used to trigger a one-shot postpone that predispositions a semiconductor switch. The semiconductor drives a TRIAC (strong state transfer) that turns on/off the warmth blower associated with it. At the point when a wet hand is embedded under the vent and hinders the view of the sensor, the blower begins to blow consequently as long as the hands are as yet obstructing the movement sensors, else it will stop. The seven-segment display shows the temperature of the smothered air in degree C and resets all the while with turning off of the dryer. This drying framework has been planned and mimicked utilizing constant MatLab17b reproduction tool kit.

2. Hand Dryer System Analysis

This venture plan and execution of programmed hand-dryer with temperature show is accomplished in a few hinders all joined to shape one practical unit. The main square in the movement sensor-coupler acknowledged with laser diode and LDR whose yield is molded by 74LS132 package that creates control rationale. This control rationale is utilized to inclination a semiconductor switch that stimulates the electromagnetic transfer which switches the dryer. The control rationale is additionally used to trigger/power the temperature show circuit. This area is acknowledged with IC direct temperature sensor (LM35) whose yield is taken care of to a quad-comparator with Hysteresis. This comparator yield reset a recurrence generator which is checked by a 2-digit decimal tallying unit that shows the temperature of the blowers air in C^0. The framework dries the hand and shows the temperature utilizing seven section show. The significant target of this task is to structure and actualize programmed hand-dryer with temperature show. The design of the block diagram of hand-taking with motion sensor using a microcontroller according to Figure 1. From Figure 1, it appears that the system consists of sensors LM35 [3], [4], [13], [14], microcontroller [14]–[16], and driver to activate the motion sensors and dryer.

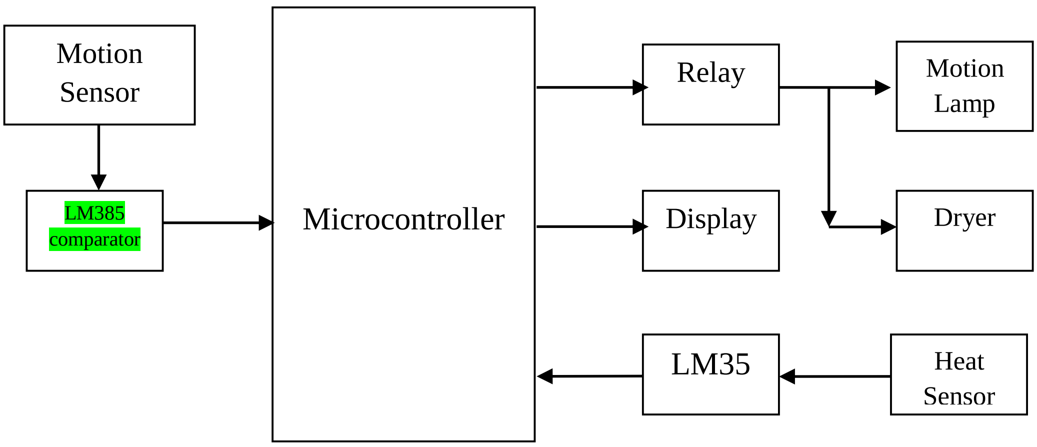


Fig. 1. Heat Dryer System block diagram

The power supply has been utilized to provide voltage to every part in the circuits, hence, when the sensor observes an input signal [17]–[23] it will convert it into a voltage signal form, which will then compared to the LM358 comparator [13], [24] and then executed by a microcontroller [25]–[27]. The microcontroller then orders the relay to turn on the dryer and motion sensor. An acknowledge signal will instruct the LCD [28]–[31] to show the stored statements before and after the sensing process of the object.

2.1. Dryer Heat Transfer

The heat energy requirements for the drying process has been discussed and formulated in literature [ ]. The rates of drying are generally determined by the rates at which heat energy can be transferred to the water or to the ice in order to provide the latent heats, though under some circumstances the rate of mass transfer (removal of the water) can be limiting. All three of the mechanisms by which heat is transferred - conduction, radiation and convection - may enter into drying. The relative importance of the mechanisms varies from one drying process to another and very often one mode of heat transfer predominates to such an extent that it governs the overall process.

As an example, in air drying the rate of heat transfer is given by [12]:

$$q=h_sA(T_d-T_s) \quad (1)$$

where q is the heat transfer rate in Js–1, hs is the surface heat-transfer coefficient $Jm^{-2}\ s^{-1}\ {}^oC^{-1}$, A is the area through which heat flow is taking place, m^2, Ta is the air temperature and T_s is the temperature of the surface which is drying, ^oC.

To take another example, in a roller dryer where moist material is spread over the surface of a heated drum, heat transfer occurs by conduction from the drum to the foodstuff, so that the equation is

$$q=UA(T_d-T_s) \quad (2)$$

where U is the overall heat-transfer coefficient, Td is the drum temperature (usually very close to that of the steam), Ts is the surface temperature of the food (boiling point of water or slightly above) and A is the area of drying surface on the drum. The value of U can be estimated from the conductivity of the drum material and of the layer of foodstuff. Values of U have been quoted as high as 1800 Jm-2s-1oC-1 under very good conditions and down to about 60 $Jm^{-2}\ s^{-1o}\ C^{-1}$ under poor conditions.

In cases where substantial quantities of heat are transferred by radiation, it should be remembered that the surface temperature of the food may be higher than the air temperature. Estimates of surface temperature can be made using the relationships developed for radiant heat transfer although the actual effect of combined radiation and evaporative cooling is complex. Convection coefficients also can be estimated using the standard equations. For freeze drying, energy must be transferred to the surface at which sublimation occurs. However, it must be supplied at such a rate as not to increase the temperature at the drying surface above the freezing point. In many applications of freeze drying, the heat transfer occurs mainly by conduction. As drying proceeds, the character of the heat transfer situation changes. Dry material begins to occupy the surface layers and conduction must take place through these dry surface layers which are poor heat conductors so that heat is transferred to the drying region progressively more slowly.

2.2. Dryer Effeciency

Another useful measure for air drying such as in spray dryers, is to look at a heat balance over the air, treating the dryer as adiabatic with no exchange of heat with the surroundings. Then the useful heat transferred to the food for its drying corresponds to the drop in temperature in the drying air, and the heat which has to be supplied corresponds to the rise of temperature of the air in the air heater. So this adiabatic air-drying efficiency, η, can be defined by:

$$\eta=(T_1-T_2)(T_1-T_d) \quad (3)$$

where T_1 is the inlet (high) air temperature into the dryer, T_2 is the outlet air temperature from the dryer, and T_a is the ambient air temperature. The numerator, the gap between T_1 and T_2, is a major factor in the efficiency.

2.3. System Flow Chart program

Figure 2 represents the framework stream graph chart. It begins the procedure by put the hand at nearest distance from the hand dryer motion sensor which will detect the hand motion and convert it into voltage signal. In the instatement step, the LCD will show the word WELCOME. When recognizing a hand, the framework is accepting information from the simulated infrared sensor, however when no hand is identified, it comes back to the past advance. At the point when the sensor has distinguished a hand, the dryer and the light are on and the LCD will show DRYER ON. The drying time is 25 seconds that has been calculated from the "clock" unit provided by MatLab17b Simulink toolbox. Following 25 seconds, the dryer and the light lights OFF and the LCD will show DRYER OFF.

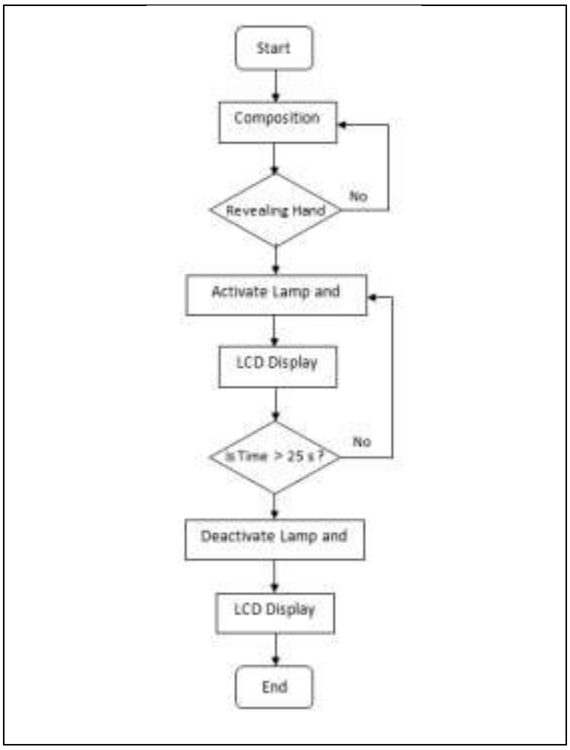


Fig. 2. System flowchart diagram

3. Dryer Implementation and Simulation Results

At the time when the sensor has a voltage of 5 VDC, the infrared LED will be activated by sending light, and the photodiode is prepared to get the information. Then, when the infrared LED is reflected when contacts the objects that reflect it, the photodiode gets information from the infrared. The outputs of this photodiode is a voltage that goes legitimately to the comparator circuit. The yield of the photodiode will be estimated in the comparator circuit and afterward communicated to the microcontroller as parallel numbers (0 and 1). When the microcontroller gets information 1, the microcontroller will contact the relay to turn the light and dryer ON for 25 seconds and change the presentation on the LCD, and when the microcontroller gets information 0, the microcontroller will contact the hand-OFF to stop the light and dryer. The infrared sensor test Figure 3 shows that by increasing the separation of the hand set before the simulated infrared sensor, the resulting voltage from the infrared sensor will be vey lettle, and the closer the hand is put on the infrared sensor, the more prominent will yield. The hand is in a perfect world inside 4-10 cm from the infrared sensor in light of the fact that at that separation, the output could be gotten by the microcontroller at present time. The lab trial of the model hand dryer is outfitted with a light with a LCD show dependent on microcontroller unit provided by Matlab17b simulation program. Noting that Excell files are compatable with MatLab17b simulation program tools which provides importing as well exporting tool functions for read/write data purposes.

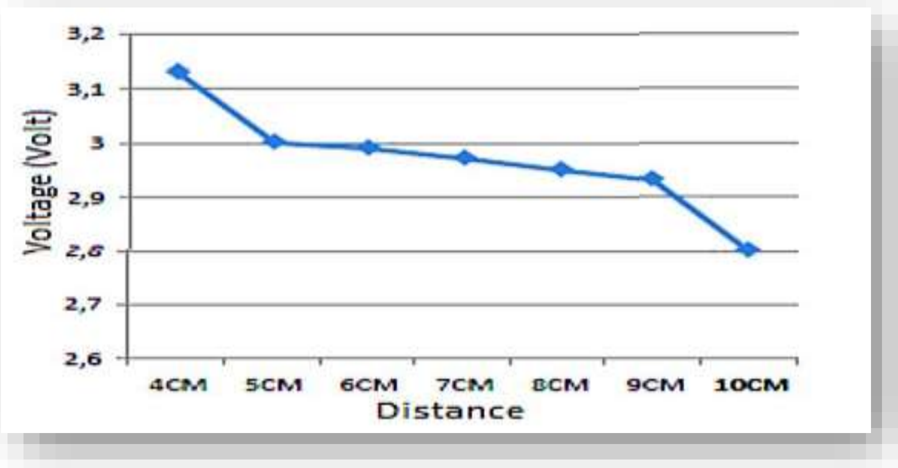
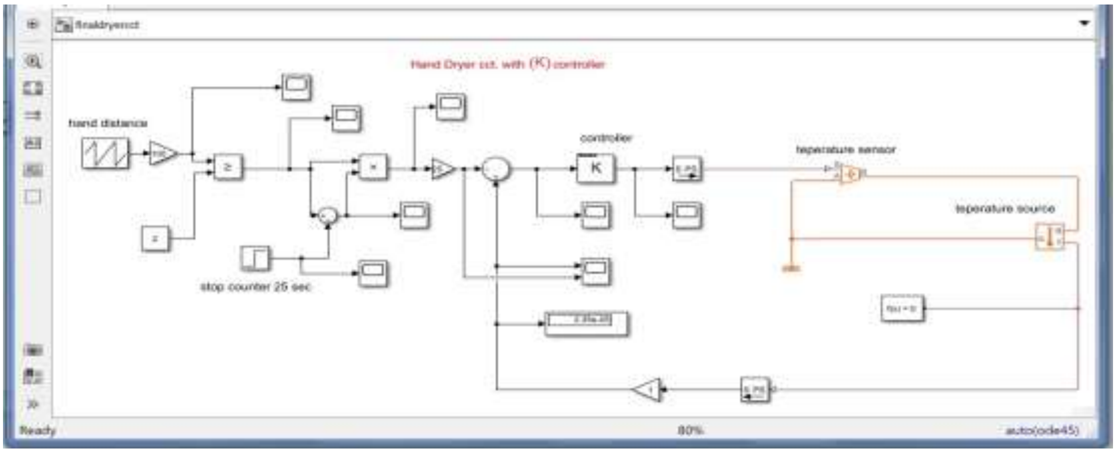
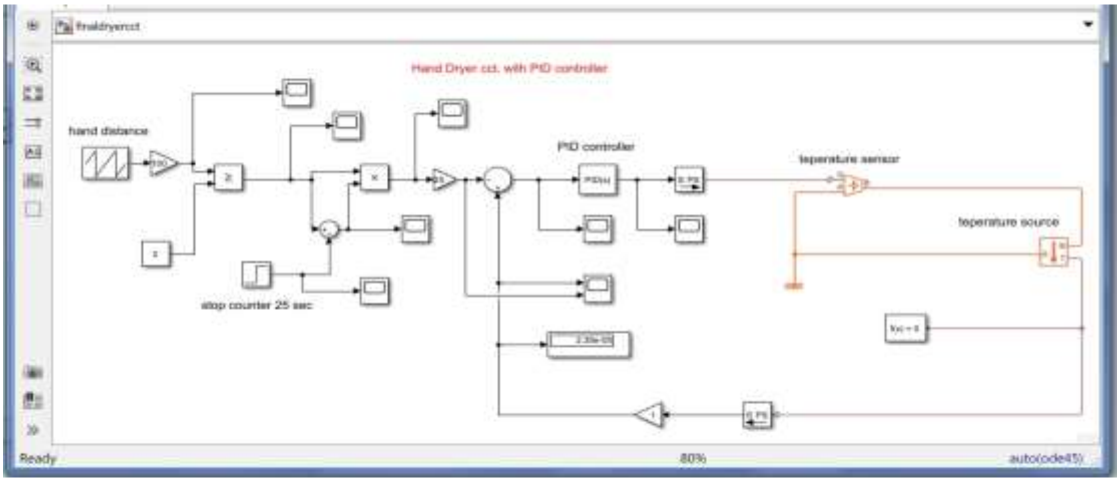


Fig. 3. The output response of the infrared sensor

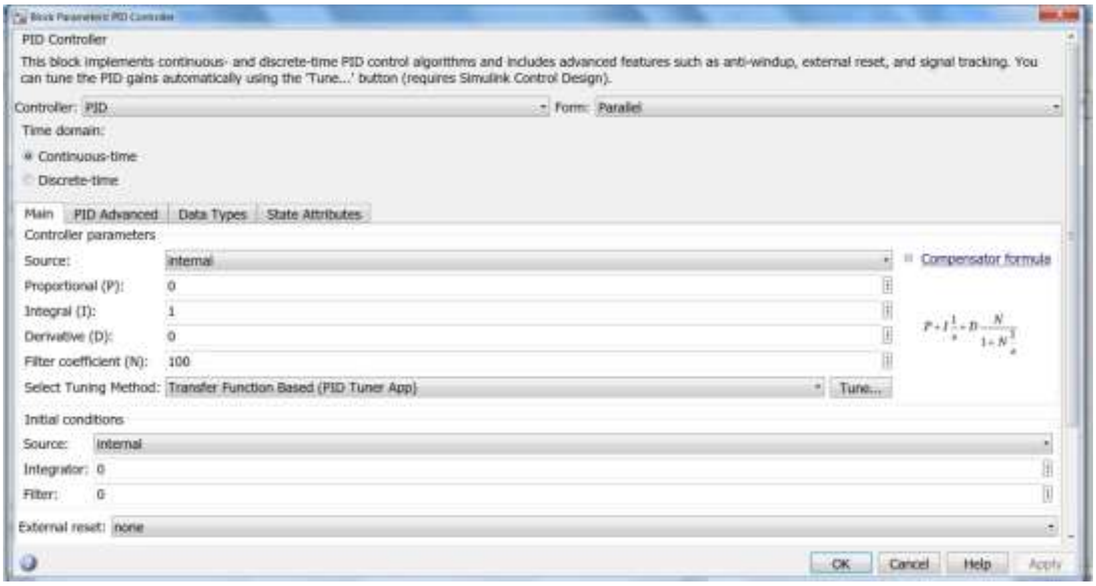
New commitment to this task have been presented through the utilizing of the proportional integral derivative PID controller. The impact of the PID will upgrading the general dryer framework reaction which will make it abstained and progressively steady. Figure. 4, delineates the hand dryer circuit utilizing MatLab17b Simulink toolbox. In this figure, the dryer operation circuits have improved when the PID controller included. All the tested signals from the PID controller, the movement sensor, the temperature of the dryer radiator signal, the blunder temperature signal, and the dryer reaction activity signal have been examined and estimated without and with the PID controller and appeared in Fig. 5, and 6 individually.



(a)



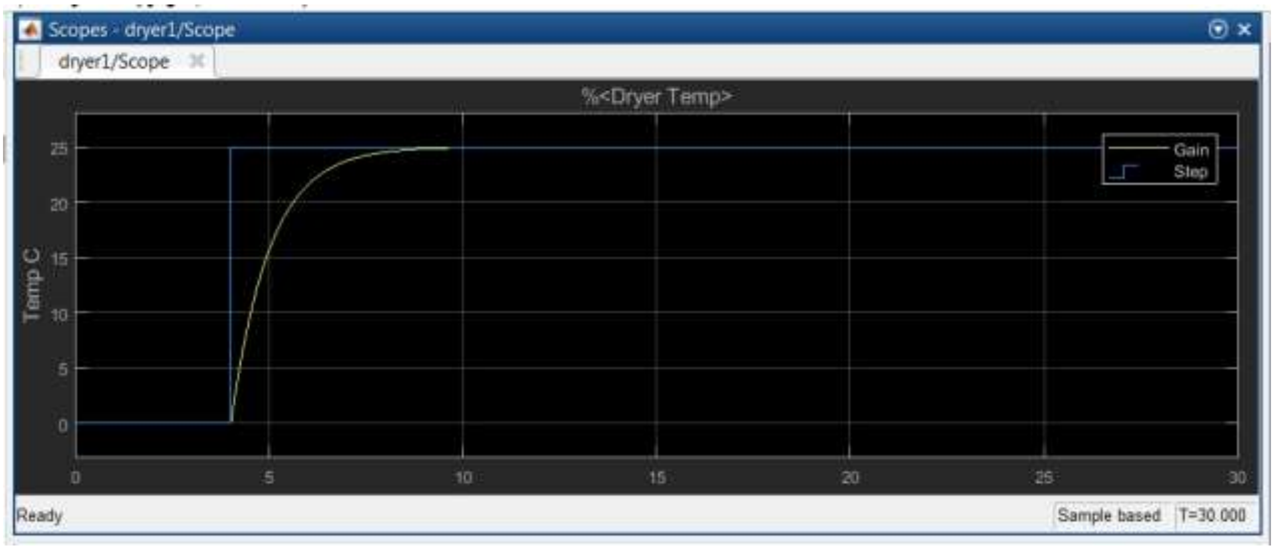
(b)



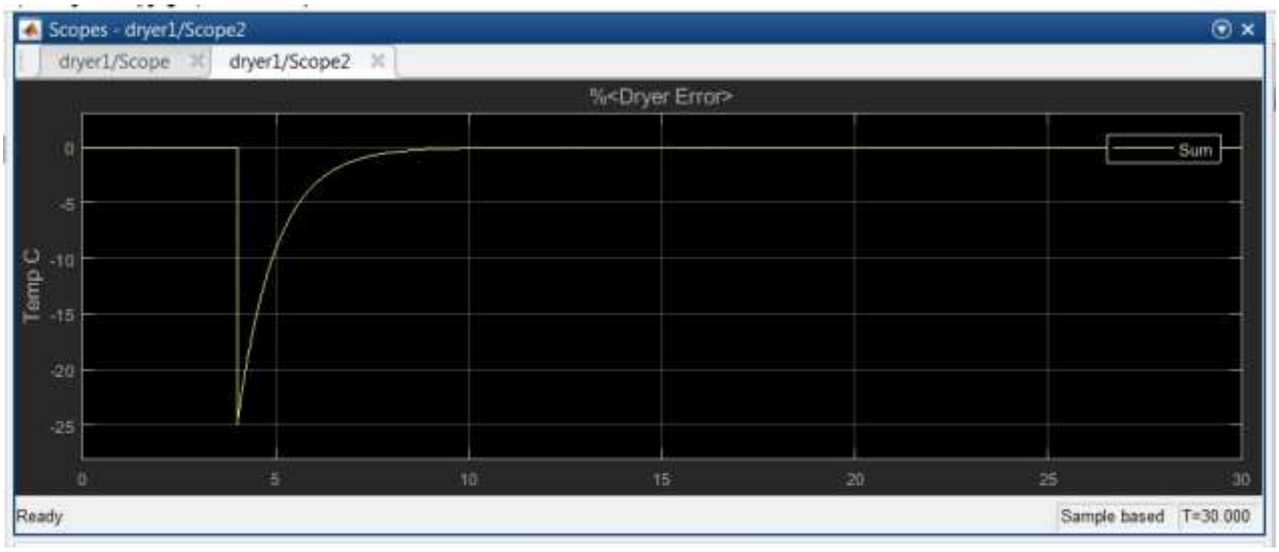
(c)

Fig. 4. The Simulink dryer circuit. (a). with Integral (K) controller, (b) with PID controller, (c) PID parameters.

Depending on the data retrieval of the defined range measurements, many different voltage readings are obtained. In 20 times experiments with a distance of 4 cm, the average voltage obtained is 4 volts. At a distance of 10 cm experiments, the average voltage obtained is 1.3 volts, which is reduced due to the increasing distance between hand and dryer sensor. On the other hand, when using the ordinary dryer without PID controller, the resulting error signal value is 0.4%. Wile when including the PID controller, the error value will be 0.14 percent. This will show an enhancement in the overall dryer response and performance round 25%.

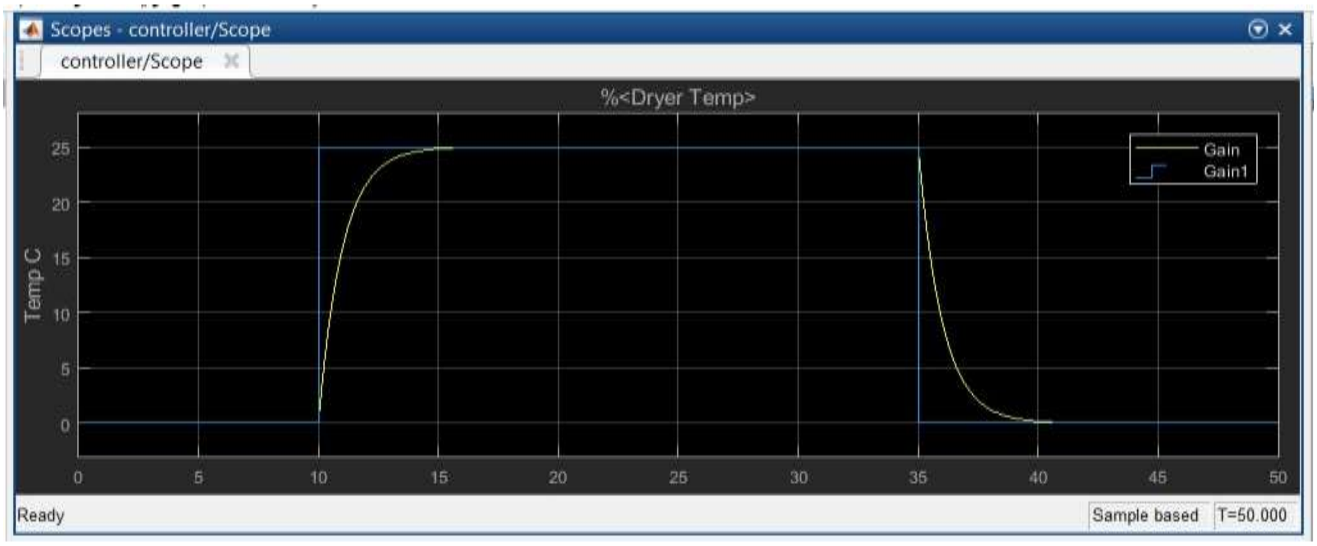


(a)

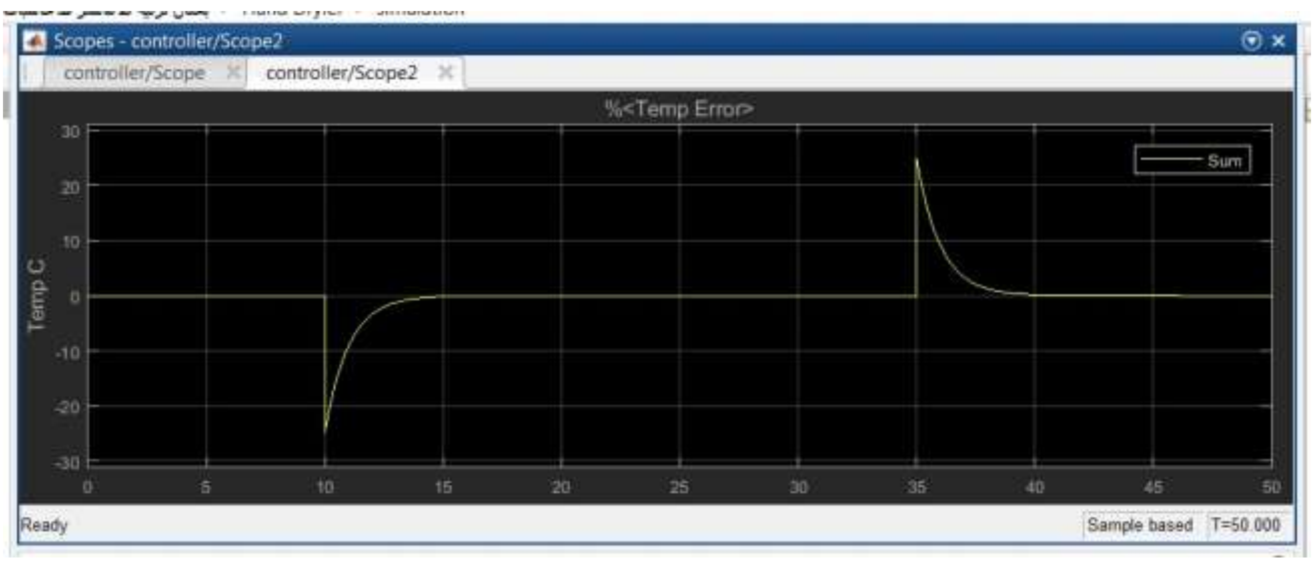


(b)

Fig. 5. The dryer system without PID controller. (a) Dryer operation temperature signal, (b) Dyer error signal.



(a)



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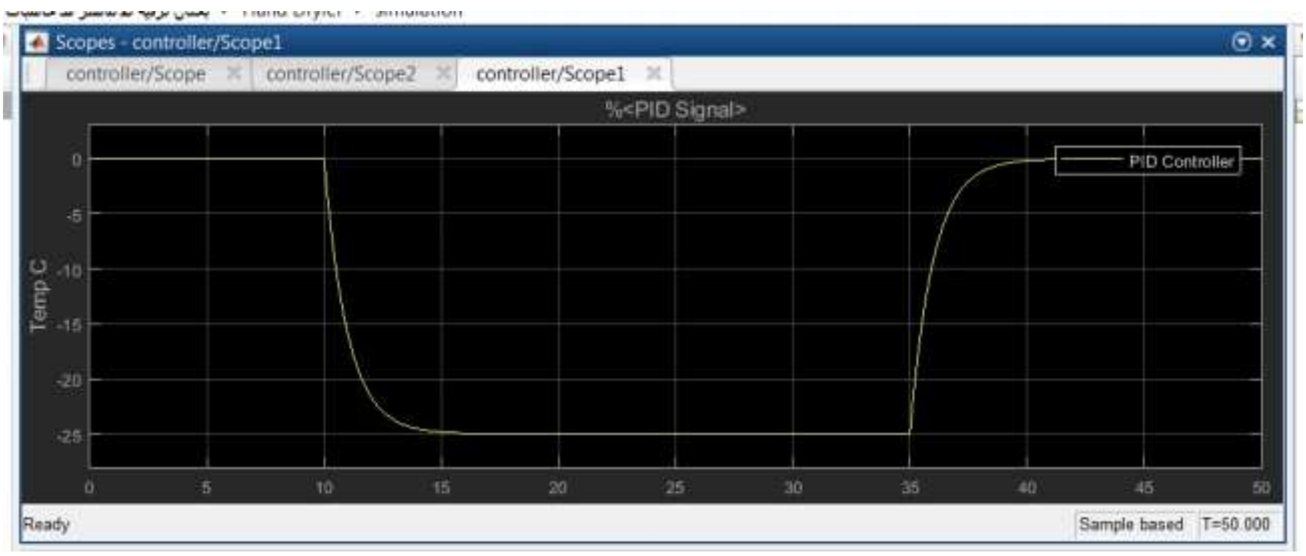

(c)

Fig. 6. The dryer system with PID controller. (a) Dryer operation temperature signal, (b) Dyer error signal. (c) PID controller signal.

4. Conclusions and Future Work

In this research, a new type of hand dryer system has been introduced. The process of designing, simulating, examining, and data collection, of the overall system has been accomplished via presenting a PID controller inside the hand dryer circuit. The technology of the system operation together with the LCD display would work on the basis of the sensory feedback. If the sensor detects the hands, the hand dryer and the LCD display is ON, and if the sensor does not detect the hands, the dryer and the LCD lamp is OFF. The ideal distance of the hand from the infrared sensor is 1 to 10 cm. The LCD displays a text when the dryer is either on or off. It also displays a WELCOM text when the dryer and the heat sensor are working. The use of hand dryer tools with heat sensor is more hygienic in 20 times experiments with a distance of 4 cm, the average voltage obtained is 3 volts. Based on the data, the error value is 0.31 percent. The heat sensor temperature response has more enhanced by engaging the PID controller, so that the error value is reduced by 25%. Depending on the data retrieval, the period of the hand dryer has a better improvement by 0.25 seconds than other dryer types presented by [1,8,9,18] on average so that the error is batterly enhanced .

References

[1] H. Lin, M. Rui-Qi, C. Shi-Gang, Z. Yong-Li, and W. Xmg-Li, “Design of intelligent plant growth cabinet environment monitoring and control system,” in 2018 Chinese Control And Decision Conference (CCDC), 2018, pp. 1472–1475.

[2] D. Chen et al., “Design of Temperature Intelligent Control System based on Transcranial Micro Current Depression Therapeutic Instrument,” in 2018 IEEE International Conference on Mechatronics and Automation (ICMA), 2018, pp. 1345–1349.

[3] B. S. Mandala, S. Sumaryo, and Estananto, “Smart Gold Fish Eggs Nursery with Microcontroller,” in 2018 International Symposium on Electronics and Smart Devices (ISESD), 2018, pp. 1–6.

[4] A. K. Rego Segundo, J. A. N. Cocota, and D. V. M. Ferreira, “Development of an educational tool for control engineering,” in 2015 IEEE Global Engineering Education Conference (EDUCON), 2015, vol. 2015-April, no. March, pp. 594–601.

[5] D. A. Polyakov, D. A. Yurchuk, and K. I. Nikitin, “Digital temperature meter of polyethylene insulation,” in 2015 International Siberian Conference on Control and Communications (SIBCON), 2015, pp. 1–4.

[6] C. Yingying, X. Xiuying, W. Ming, and J. Haiming, “Design of a control system for a fresh air conditioner,” in The 27th Chinese Control and Decision Conference (2015 CCDC), 2015, pp. 5670– 5675.

[7] N. Hassan, S. I. Abdullah, A. S. Noor, and M. Alam, “An automatic monitoring and control system inside greenhouse,” in 2015 3rd International Conference on Green Energy and Technology (ICGET), 2015, pp. 1–5.

[8] T. Pawlenka and J. Skuta, “Security system based on microcontrollers,” in 2018 19th International Carpathian Control Conference (ICCC), 2018, pp. 344–347.

[9] A. I. LITA, D. A. VISAN, L. Mihai IONESCU, and A. G. MAZARE, “Temperature Control System for Accelerated Aging Tests on Printed Circuit Boards,” in 2018 10th International Conference on Electronics, Computers and Artificial Intelligence (ECAI), 2018, pp. 1–4.

[10] W. S. M. Sanjaya et al., “The development of quail eggs smart incubator for hatching system based on microcontroller and Internet of Things (IoT),” in 2018 International Conference on Information and Communications Technology (ICOIACT), 2018, vol. 2018- Janua, pp. 407–411.

[11] Y. P. Dhole and V. A. More, “Embedded Ethernet microcontroller prototype for different parameter monitoring and control,” in 2015 International Conference on Energy Systems and Applications, 2015, no. Icesa, pp. 429–431.

[12] S. A. Ili Flores, H. J. Konno, A. M. Massafra, and L. Schiaffino, “Simultaneous Humidity and Temperature Fuzzy Logic Control in Neonatal Incubators,” in 2018 Argentine Conference on Automatic Control (AADECA), 2018, pp. 1–6.

[13] Qurat.ul.Ain, M. Shah, M. Khan, and S. A. Mahmud, “Implementation of SCADA for multiple telemetry units while using GSM for communication,” in 2015 International Conference on Emerging Technologies (ICET), 2015, pp. 1–4.

[14] P. Roy, J. Saha, N. Dutta, and S. Chandra, “Microcontroller based automated room light and fan controller,” in 2018 Emerging Trends in Electronic Devices and Computational Techniques (EDCT), 2018, pp. 1–4.

[15] F. H. Purwanto, E. Utami, and E. Pramono, “Design of server room temperature and humidity control system using fuzzy logic based on microcontroller,” in 2018 International Conference on Information and Communications Technology (ICOIACT), 2018, vol. 2018- Janua, pp. 390–395.

[16] S. Bipasha Biswas and M. Tariq Iqbal, “Solar Water Pumping System Control Using a Low Cost ESP32 Microcontroller,” in 2018 IEEE Canadian Conference on Electrical & Computer Engineering (CCECE), 2018, vol. 2018-May, pp. 1–5.

[17] C. Cherciu, C. I. Cherciu, and D.-I. Nastac, “A portable device for intercepting and retransmission of infrared modulated signals,” in 2015 IEEE 21st International Symposium for Design and Technology in Electronic Packaging (SIITME), 2015, pp. 277–280.

[18] B. Singh, “Armed anti infiltration robot based on peripheral interface controller using infrared ranging technique with single disc system,” in 2014 International Conference on Computing for Sustainable Global Development (INDIACom), 2014, pp. 583–586.

[19] X. Han, “Infrared remote control design based on single chip microcomputer,” in 2015 IEEE International Conference on Computer and Communications (ICCC), 2015, pp. 245–249.

[20] M. A. M. Fisol and W. M. Jubadi, “Ultrasonic and infrared repelling device for controlling the population of rat in paddy field,” in 2010 IEEE Asia Pacific Conference on Circuits and Systems, 2010, pp. 359–361.

[21] V. P. Rachim and W. Y. Chung, “Wearable-band type visible-near infrared optical biosensor for non-invasive blood glucose monitoring,” Sensors Actuators, B Chem., vol. 286, no. January, pp. 173–180, 2019.

[22] R. A. De Lima and E. Fontana, “Single controller of DFB lasers for the simultaneous detection of multiple gases in the near infrared,” SBMO/IEEE MTT-S Int. Microw. Optoelectron. Conf. Proc., vol. 2015-Decem, pp. 1–4, 2015.

[23] C. Pahl and E. Supriyanto, “Infrared based clinical landmark determination for ultrasound image acquisition,” in 2015 38th International Conference on Telecommunications and Signal Processing (TSP), 2015, pp. 236–240.

[24] M. Noushad, B. Tauheed, S. A. Khan, and M. A. Khan, “Wireless monitoring of temperature and humidity using sensor array,” in 2015 Annual IEEE India Conference (INDICON), 2015, pp. 1–5.

[25] D. F. G. Junco, D. F. Diaz Caro, M. S. C. Forero, and I. A. R. Ruge, “Agrometeorological monitoring station based microcontroller and bluetooth communication,” in 2015 IEEE 2nd Colombian Conference on Automatic Control (CCAC), 2015, pp. 1–5.

[26] A. Mohini, “Microcontroller based orbital motion shaker,” in 2015 International Conference on Intelligent Informatics and Biomedical Sciences (ICIIBMS), 2015, pp. 115–120.

[27] C. Rori, R. Munir, D. Paseru, and P. Manembu, “Fan temperature detection using microcontroller,” in 2015 1st International Conference on Wireless and Telematics (ICWT), 2015, pp. 1–5.

[28] F. A. Kazan, H. Terzioglu, and A. C. Agacayak, “The Design of a Test & Development Board for the Training of PIC18F4550 Microcontroller,” in 2015 2nd International Conference on Information Science and Control Engineering, 2015, pp. 951–955.

[29] V. P. Mohale, A. G. Hingmire, and D. G. Babar, “Ingenious energy monitoring, control and management of electrical supply,” in 2015 International Conference on Energy Systems and Applications, 2015, no. Icesa, pp. 254–257.

[30] A. A. Aldair, A. T. Rashid, and M. Mokayef, “Design and Implementation of Intelligent Control System for Egg Incubator Based on IoT Technology,” in 2018 4th International Conference on Electrical, Electronics and System Engineering (ICEESE), 2018, pp. 49–54.

[31] Chunli Jiang, Zhenglin Li, Yang Zhou, Xiaohu Qin, and Zeshuang Zhao, “Design of constant temperature boiler system with fuzzy control and remote monitoring function,” in 2015 IEEE International Conference on Communication Problem-Solving (ICCP), 2015, pp. 38–42.