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Hardware simulation platform for Industrial Automation applications

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Abstract. This paper provides solution for the academic community during this COVID-19 pandemic where majority of student fraternity limited to the homes. The industrial automation application is related to the integration of input and output devices like sensors and actuators executed in laboratories under the expertise guidance for interconnection and logic building. Due to the lack of access to academic laboratories hands on in requirement to retain and interest the ability of circuit building and logical comprehension online virtual platform AUTODESK TINKERCAD is proposed an demonstrated with three industrial automation application Chemical cleaning process of metallic objects, Automated filling of milk tank and Self-cleaning and solar tracking of PV panel. Automation components used for the application, there integration, simulation and results are discussed and demonstrated to recorded video links.

Keywords: Tinker CAD, IIOT, Arduino UNO, ultrasonic sensor, LDR (light dependent resistor).

1.**Introduction**

Industrial automation is a process of operating machines and other industrial equipment with the help of digital logical programming and reduce human interaction in decision and manual command process with the help of mechanized equipment. Industrial automation as some benefits like High productivity, High quality, High flexibility, High information Accuracy and High safety. The reason behind to automation is to increase labor productivity, reduce labor cost, reduce or remove routine manual and clerical tasks, improve worker safety, reduce manufacturing lead time, accomplish what cannot be done manually, avoid the high cost of not automating.

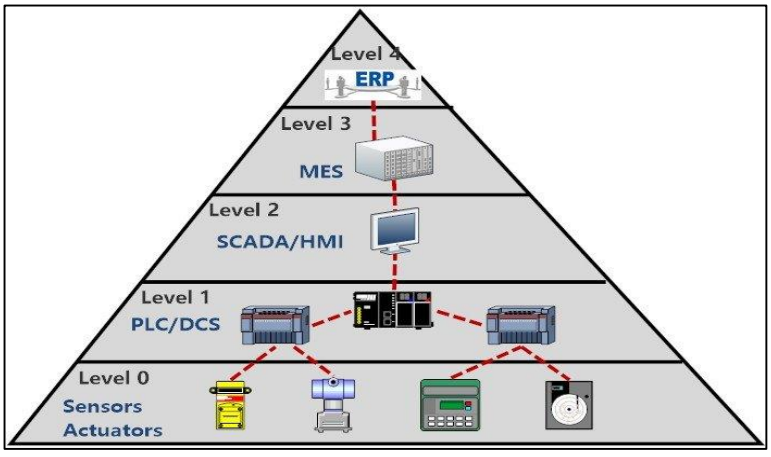

Figure:1 Industrial automation architecture

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The typical industrial automation applications are realized used the control strategies among IO devices using programmable logic controllers. The industrial automation architecture levels are pictorially represented. where level 1 and level 2 process can be achieved virtually using tinker CAD platform.

1.1 Virtual platform Tinker CAD:

In tinker CAD we will observe some features like camera controls, for varies snaps, transformation, there is a work plane for different 3D diagrams, we can prepare the shapes and object modification in 2D or 3D design and align the diagrams in perfect manner, we can create the smart duplicate of another diagrams. Import of 3D and 2D diagram from the external sources, we can export our project. To do the analysis of our own creation circuit design when we are purchasing any components outside initially, we use the tinker CAD to get results correctly, in tinker CAD we can make the programmable circuits by using the Arduino for varies automation applications.

1.1.2 Automation Components:

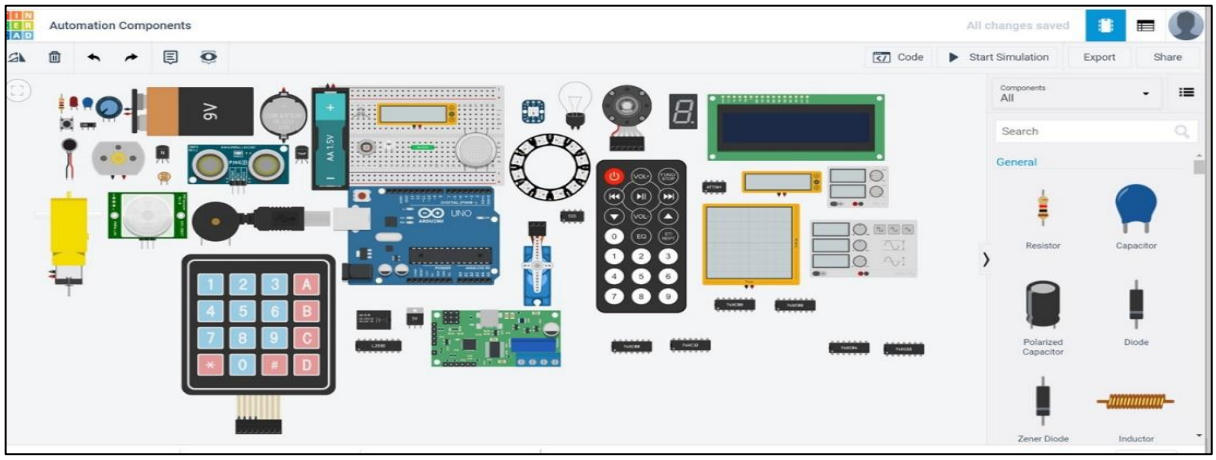

Figure 2: Tinker CAD components

The virtual platform offers components like Arduino UNO, 16*2 LCD display for displaying, servo motor as actuator, piezo buzzer for indication, SPDT switch used as relay, DC motor, push button, LDR, Ultrasonic sensor many more as shown in figure2.In tinker cad platform offers programming for Arduino, for programming we have different types of formats like block code, text coding and block and text code. In block coding having only blocks to write a code, in text coding having only text to write a code. In block and text having both text and block parallel to write a code.

2. **Literature review**

The automation processes selected to simulate over the virtual platform significant in industries. The metallic parts used in industries often gets rusted during the course of time in their operation. The rusted material deteriorates its strength if used for heating, coating, welding and assembly. The first automation process selected is standard and applicable to the tin plating of parts made of steel, copper and copper alloys as protection against corrosion, as substrate for soldering and brazing, and for improving the frictional properties of surface, which improves the strength of the material for long life. The standard covers the processing of chemical solution for production of same material conversion coating on iron and steel surfaces at ambient temperature. The solution for those material cold, immersion process.Chemical cleaning process is basically to avoid the corrosion of material from rust. This paper provides implemented steps as the solution for industrial automation process of anticorrosion.

The second process is liquid level monitoring and control, one of the key process parameters to be observed continuously. Most of the time, it requires to switch on the pump when tank is empty and fails to remember about it. This not only causes lots of wastage of water but also consume lots of electric power. For a consumer, to predict the level of the water and control the valve eventually is not possible all the time. To overcome such issues, an

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automatic pump and water level controller is designed. The basic idea of this concept is that when the tank is empty the pump should turn ON and when tank is filled the pump should be turned OFF automatically. In this paper illustrates, how to model an automatic pump and water level controller with an ultrasonic sensor and other actuators using Arduino over virtual platform.

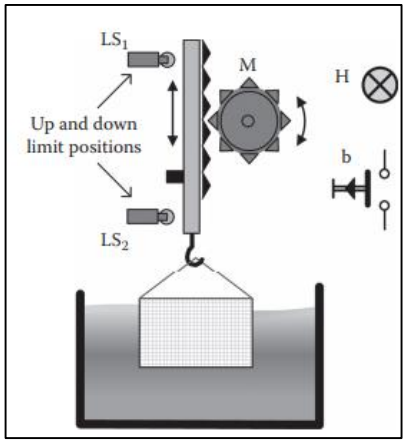

Figure3:Model for anti corrosion

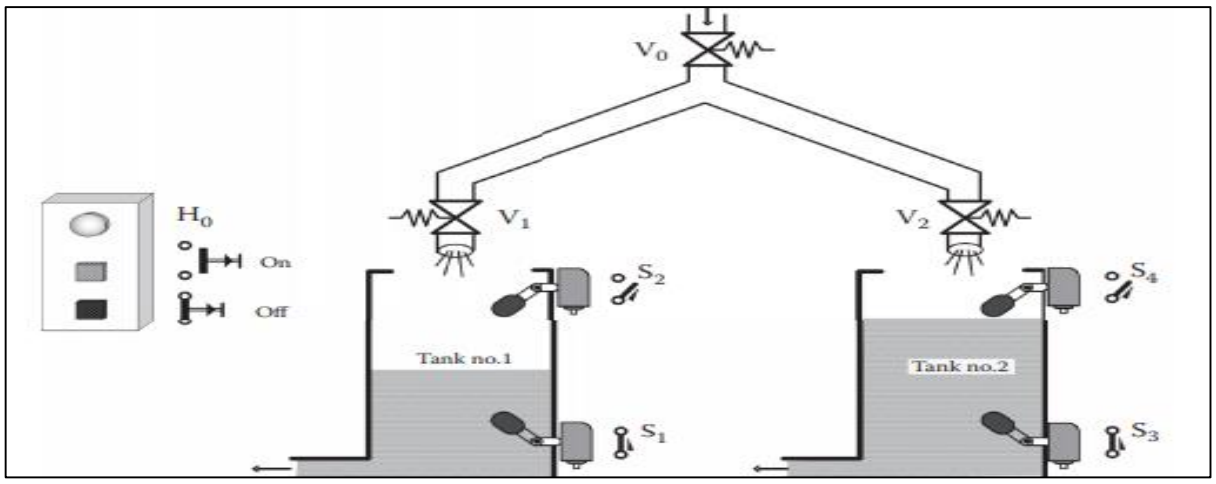

Figure 4: Milk tank filling

The proposed process steps are applicable in milk factories when there is no available of milk in tank automatically measure milk with help of ultrasonic sensor and motors will ON with help of limit switches, when tank has been filled the motors will automatically OFF, then drain valves will open to collect the milk..

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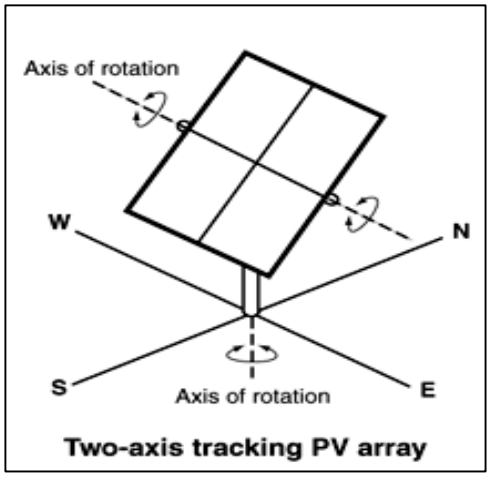

Figure 5: solar tracking

The third automation processused to track the perfect efficiency of PV voltage from sun. when the sun travels from east to west or north to south it require to know exact angle of the sun to track the irradiations from sun , to track , an automation process is proposed ,implemented LDR sensors in four directions to estimate the angles of panel with the help of servo motor.

Using the virtual platform, the multilevel automation processes are modelled designed and simulated. The steps of component integration, programming logic and the analysis is discussed.

3.**Virtual industrial applications TinkerCAD**

The selected automation processesare demonstrated with modeling the components, methodology involved followed by simulation of the chemical cleaning process of metallic objects, self-cleaning and solar tracking of PV panel, automated filling of milk tanks.

3.1 **The chemical cleaning process of metallic objects**

Methodology:

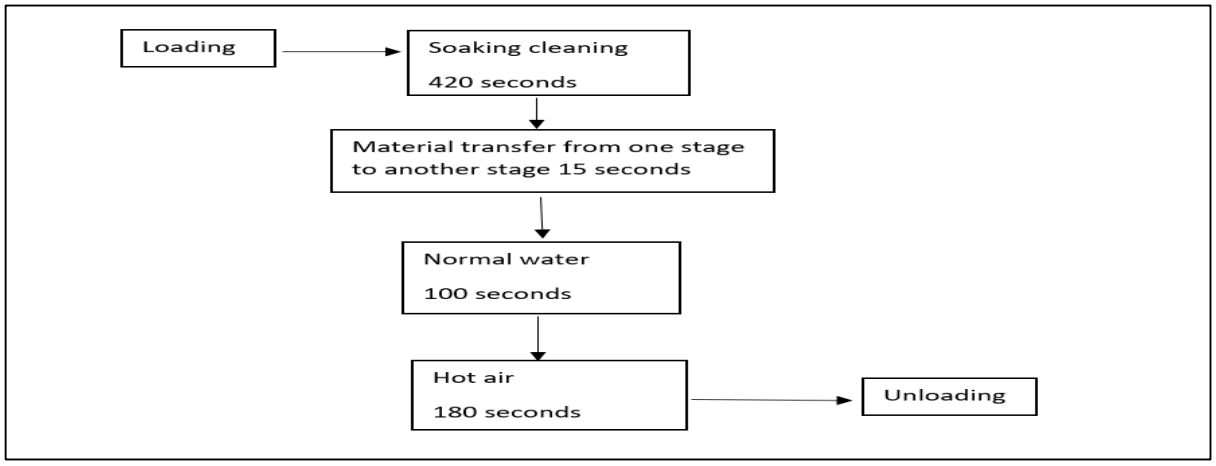

Figure 6: procedural step

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The components which are used in this process of automation are tabulated and quantity is mentioned below:
Table 1: components for cleaning process

Name	Quantity	Component

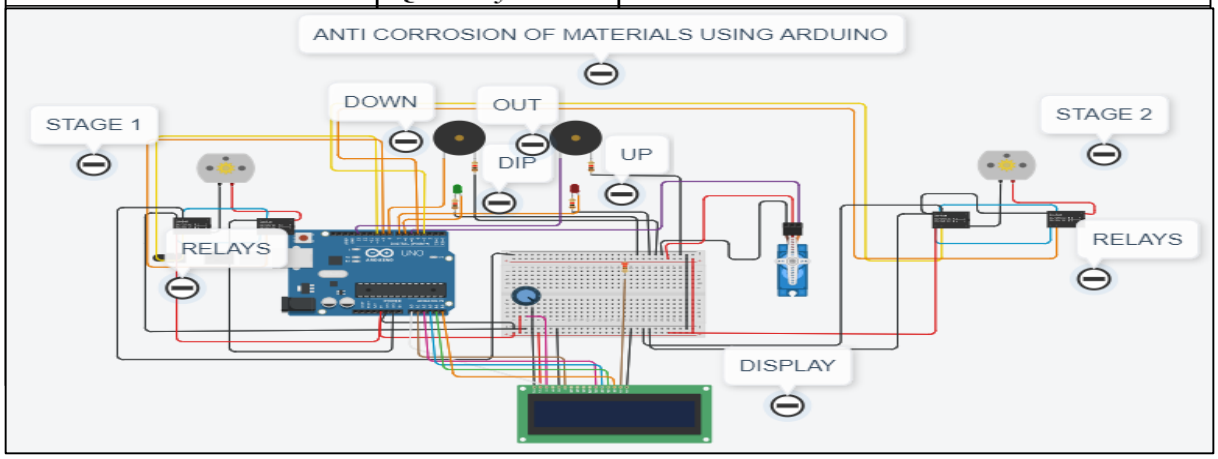


Figure7: circuit diagram for cleaning process

Typical logic is to anti corrode the material for avoiding from rust(corrosion). It use the process call seven tank process where the material will dip in the solution for some time and move to the next stage, like we have seven stages for unloading the complete process, here we have the logic has time delays based. For certain time the motor will go down with the help of relay again for some time the material will dip in solution, after some time the material will moves up with help of motor as relay actuated and again it will move to another stage with the help of servo motor we will transfer material or we can use the belt system to move the material. Here just we have to manage the system with delays based on our requirements we have to our program.
Process of case studies:

In figure7 start the process the motor will go down with certain time when relay operates and there will be an indication as buzzer ON.In figure 8 after motor come down it will stay at solution for some time to attracted solution to the material. To know the system in process given indication as LED green ON.After the solution complete the material will comes out with help of motor in reverse direction when the relay is operated, and it will give the indication as LED red will glow. The material will be out of solution to replace with another material so that the indication as buzzer ON, so process is going on and material will transfer to another stage with help of servo motor.After transfer of material , enter into stage 2 again same process conducted. Material go down, dip, lifted up and material out of solution.

Figure:8 Motor down

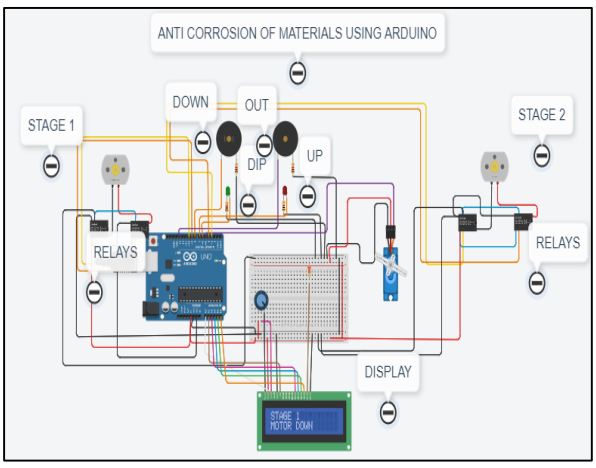
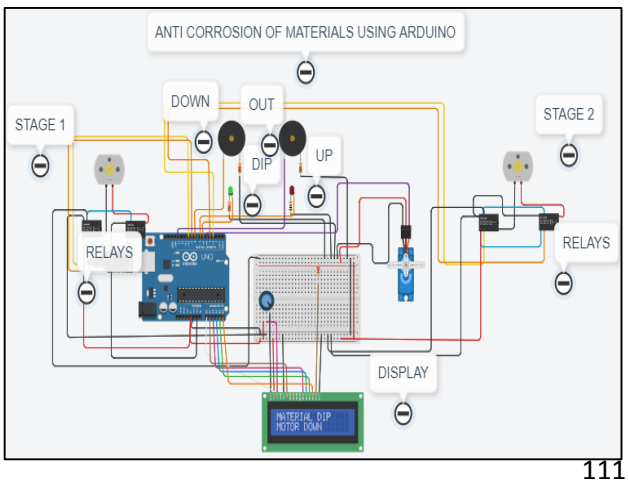


Figure:9 motor dip



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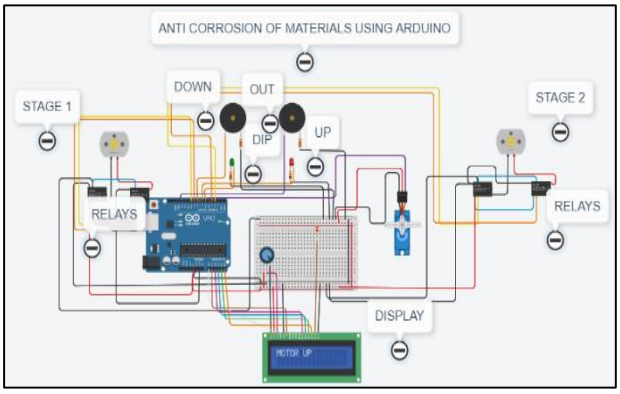

Figure 10 : Motor up

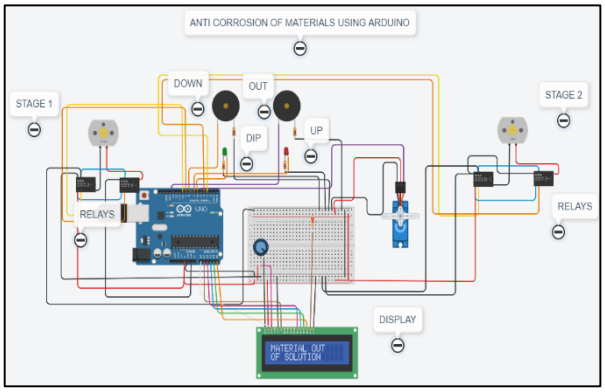

Figure 11: Material out of solution

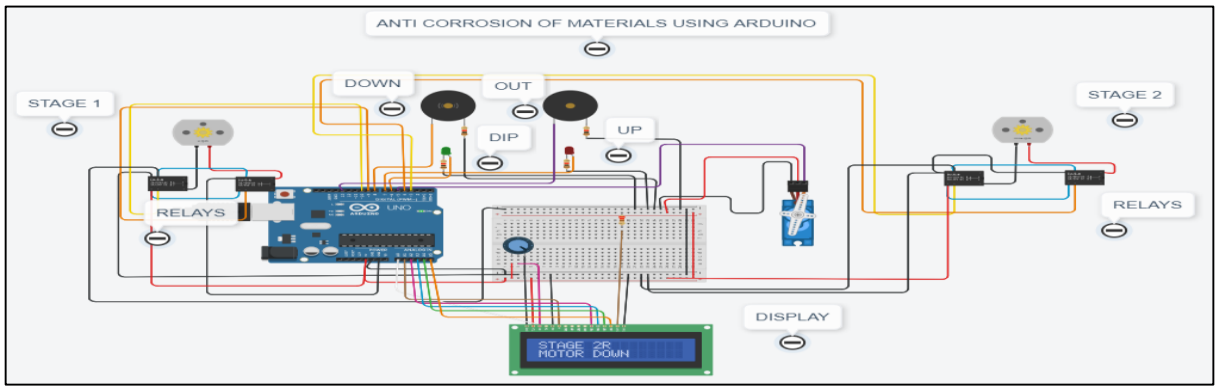

Figure 12:recursive steps

The five process stages are used for Chemical cleaning process is basically to aviod the corrosion of material from rust.The proposed solution is industrial automation specific has been implemented, to know more about this project circuit diagram,logic,connections are recored and reconstructed using the link given below.

https://www.youtube.com/watch?v=ylVSQ9OO2qI&feature=youtu.be

3.2 Self-cleaning and solar tracking of PV panel

Methodology:

The main objective is to absorb the maximum intensity of sunlight by the solar panel in order to generate power. Four LDR's are placed at the four corners of the panel which senses the light falling on them from four directions. Since the position of the sun is not constant, the point at which maximum intensity of sunlight incidents also varies. So, we use servomotors to move in the respective direction of required angle. A dual-axis tracker is used that allows panels to move in two axis, aligned both north-south and east-west.

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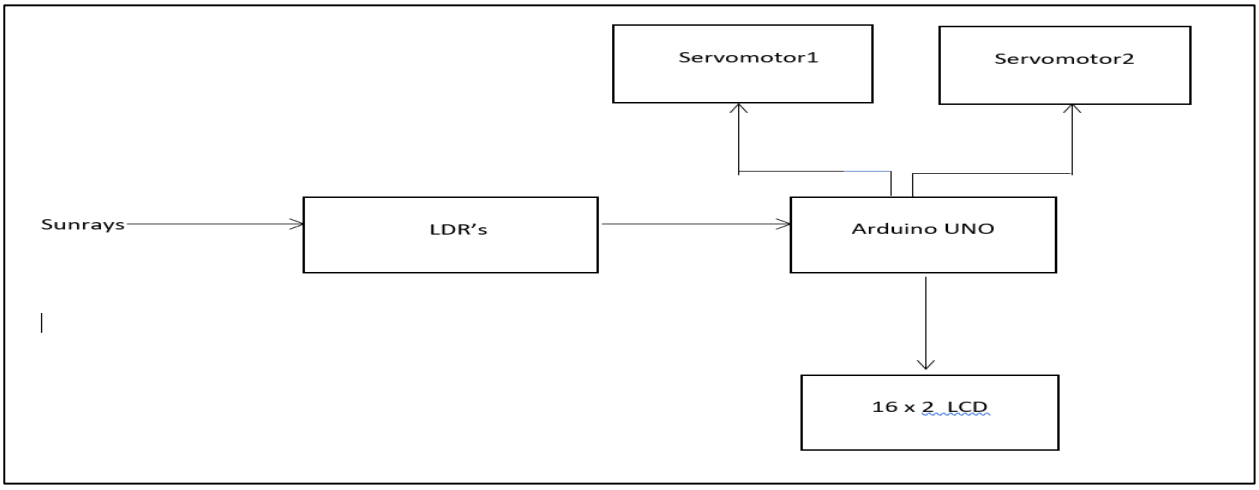

Figure 13: Block diagram

The components which are used in this process of automation are tabulated and quantity is mentioned below

Name	Quantity	Component
U1	1	Arduino UNO R3
U2	1	16 x 2 LCD
r1,r2,r3,r4	4	LDR's
S1,S2	2	Servomotors
P1,P2	2	250 k ohms, Potentiometers
R1,R2,R3,R4	4	10 k ohms, Resistors

Table 2: components for solar tracking

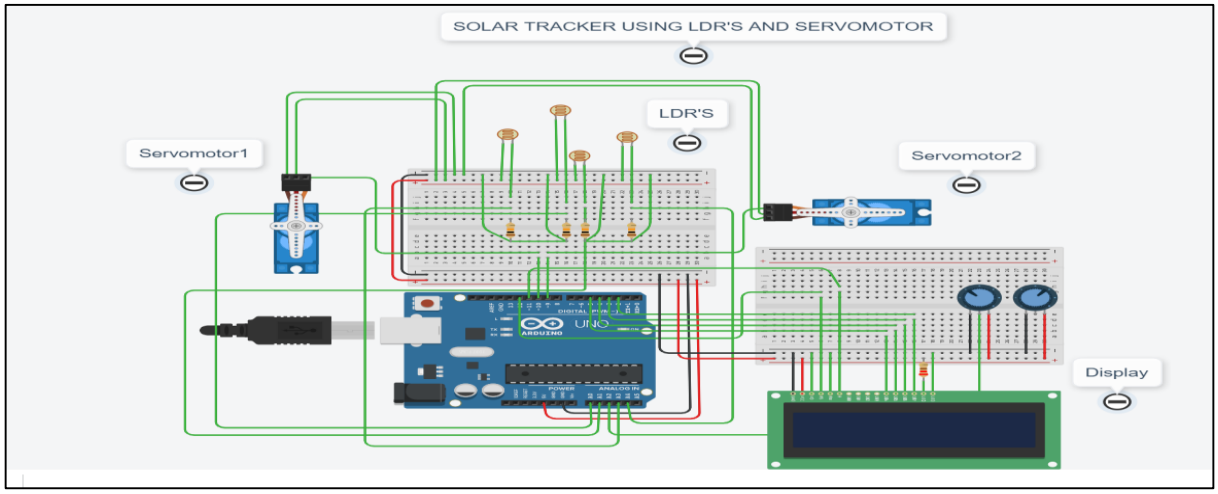

Figure 14: solar tracking

The typical configuration the four LDR's are placed at four corners of the panel. The intensities of the top left LDR, top right LDR, bottom left LDR, bottom right LDR are given as input to the analog pins of the Arduino. The average intensities of top, bottom, left and right are calculated. If the average intensity of the bottom LDR is more than top LDRs, the servomotor2 that is vertical servomotor rotates in anticlockwise direction whereas if the average intensity of top LDR is more than bottom LDRs, the servomotor2 rotates in clockwise direction. Similarly, if average intensity of right LDR is more than the left LDRs, the servomotor1 that is horizontal servomotor rotates in

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anticlockwise direction. If the average intensity of left LDR is more than right LDR, the servomotor1 rotates in clockwise direction.

Process case studies:

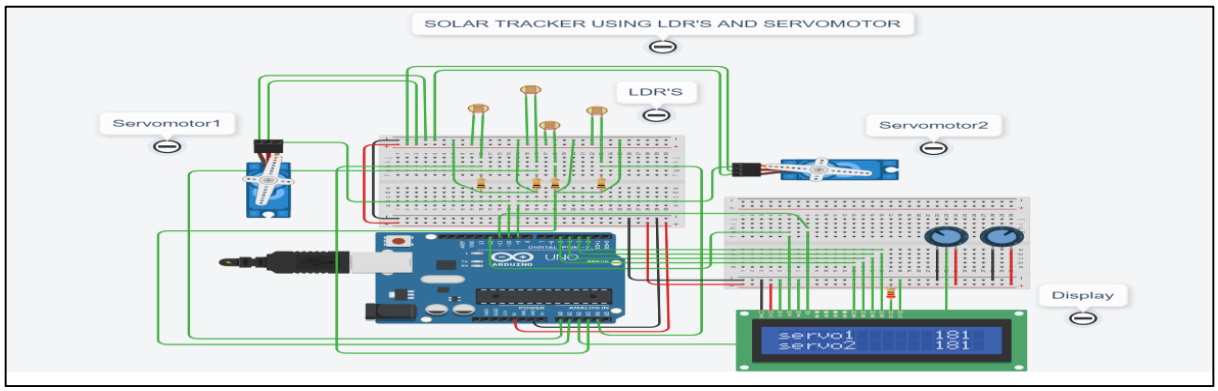

Figure 15: solar tracking angle

The process stages are used for self cleaning and solar tracking of PV array the main objective is to absorb the maximum intensity of sunlight by the solar panel in order to generate power. Four LDR's are placed at the four corners of the panel which senses the light falling on them from four directions. Since the position of the sun is not constant, the point at which maximum intensity of sunlight incidents also varies. According to the sun angle position the LDR will move according to the sun position there are four cases like left up, left bottom, right up, right bottom so according to the coordinates of sun the panel will moveto know more about this project circuit diagram,logic,connections see the link given below.

https://www.youtube.com/watch?v=WZYZyeRWyok&feature=youtu.be

3.3 Automated filling of milk tanks:

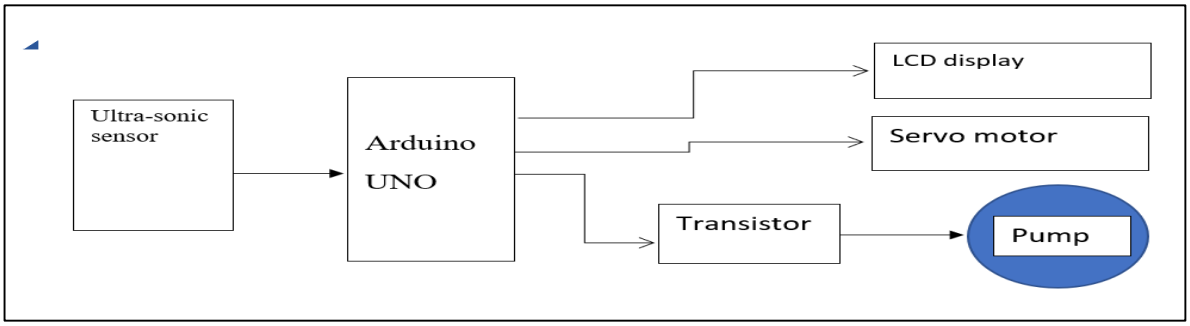

Figure16: Block diagram

The components are listed in a tabular column and quantity of each component is mentioned in Tinker platform.

Name	Quantity	Component
M1	1	DC Motor
U2	1	Arduino Uno R3
U3	1	LCD 16 x 2
R1	1	220 OHM Resistor
R2, R3, R4	3	1 K OHM Resistor

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SLIDE	1	SLIDE SWITCH
SERVO1	1	Micro Servo
TRANS1	1	TRANSISTOR

Table3:components for automatic tank filling

Methodology:

In the process of tank filling initially observe the sensor value which determines the level of milk in tank then the process begin there will be some conditions when the tank is below level sensor value automatically the motor will ON and milk will fill in the tank ,when milk level reach to that second sensor level will measured level sensor2 value will reach greater than level sensor1 value automatically the motor will turned off and again when the tank is empty there will be a indication as buzzer will blow it shows the tank is empty, again the process will be begin, to take out of milk there will a valve placed at below the tank. The details of the level sensors are shown in figure 4.

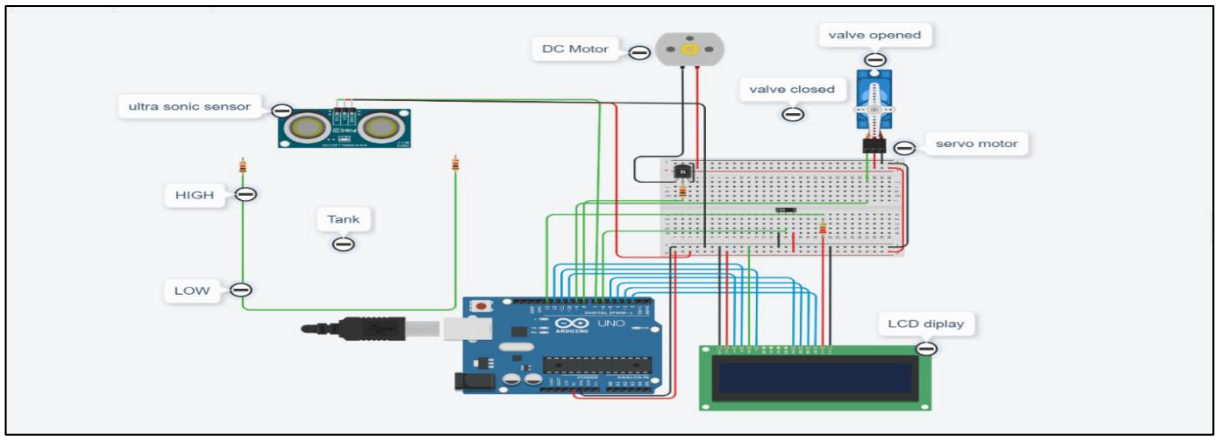

Figure 17: Automatic tank filling system

In figure 18 describes the process, when ultrasonic detects water, level is low then LCD display level and motor will on accordingly. In figure19 the water level is 96% then the motor will turn off.

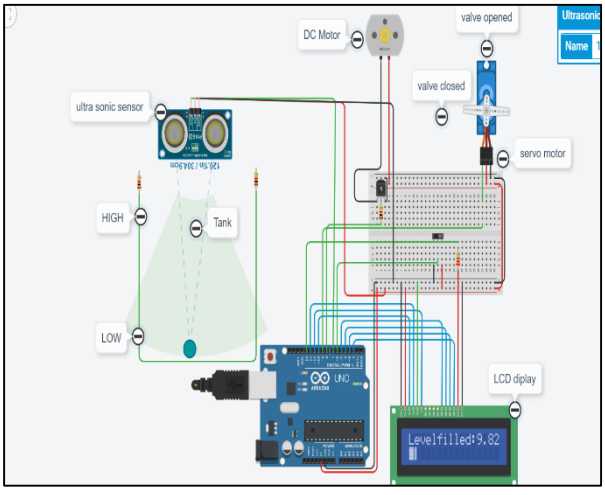

Figure:18 output for tank is empty

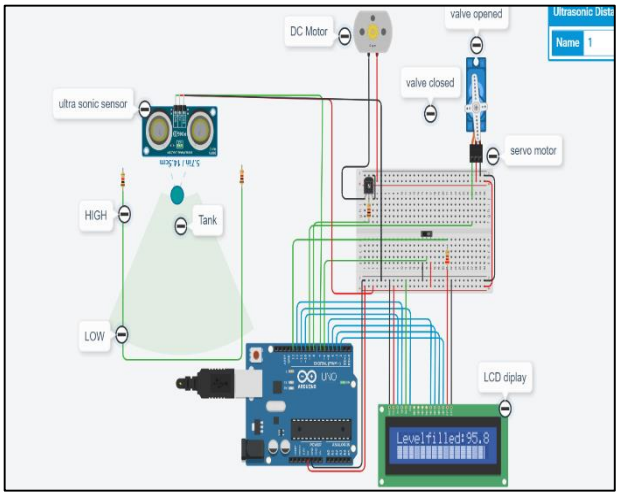

Figure:19 output for tank filled

To overcome issues low level and over level issues, an automatic pump and water level controller is designed. The automation process is intended to monitor pump and valves when the tank is empty the pump should turn ON and when tank is filled the pump should be turned OFF automatically. When the water level is high that means tank is

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full. Motor is turned off (“0” rpm) so that water is no more pumped. The valve of the tank is opened to let the water out. The the component integration and simulation steps are recorded and made available

https://www.youtube.com/watch?v=cmJ-f7SLXUc&feature=youtu.be

4. **Virtual platform challenges and Future scope:**

The tinker cad platform provides simulation of electrical, electronics and Boolean components and Arduino, At tiny as programmable modules. Provides analysis of understanding characteristics of components, power supply and display devices. The tinker cad can be used for terms called debugging and short circuit scenarios. In addition, the tinker cad provides the IOT platform simulations for the scope of realizing more industrial applications.

5. **Conclusion**

The importance of implementing automation technologies is the need of today’s infrastructure project and construction firms in order to increase the productivity and good quality of work.It has become not only an added feature in the needs of the manufacturing process but a mandatory segment which is ruling the same industry with better and secure results.we all know that robots can do much better and accurate exertion than any human in this world.

The virtual platform for simulation of automation process has been introduced and discussed the challenges user experience process during the simulation process. In this paper three industrial automations activities are demonstrated using simulation results. In The chemical process system is controlled by the motors with the help of relay actuation when time delay given to the relays, in second application the milk factory has a problem for tank filling there incorporated the automatic tank filling process by ultrasonic sensor it will measure the distance and it will sense the motor to ON or OFF, in third application to find the maximum efficiency from the sun to produce the voltage from PV array should define the angles in azimuth and elevation of sun to fetch maximum irradiation. The virtual platform offers great flexibility in connections and easy to programming through block concept.

6. **Acknowledgment**

We would like to acknowledge Electrical and Electronics department of KLEF for providing opportunity use tinker platform for skill enhancement academic program and we would like to thank Team membersMs P Bhavana, Mr. Srinath, Ms. Neelima, Mr. Sai chandu for providing their assistance in completion of work. We would like to acknowledge AUTODEK TINKERCAD for providing access to designs and circuit integrations through the virtual platform.

7. **References:**

[1] M. Kudret Yurtseven, "New technologies and industrial automation," *Innovation in Technology Management. The Key to Global Leadership. PICMET '97*, Portland, OR, USA, 1997, pp. 660-663, doi: 10.1109/PICMET.1997.653555.

[2] H. P. Breivold and K. Sandström, "Internet of Things for Industrial Automation -- Challenges and Technical Solutions," *2015 IEEE International Conference on Data Science and Data Intensive Systems*, Sydney, NSW, 2015, pp. 532-539, doi: 10.1109/DSDIS.2015.11.

[3] H. A. Sohag, M. Hasan, M. Khatun and M. Ahmad, "An accurate and efficient solar tracking system using image processing and LDR sensor," *2015 2nd International Conference on Electrical Information and Communication Technologies (EICT)*, Khulna, 2015, pp. 522-527, doi: 10.1109/EICT.2015.7392008.

[4] Y. Mizokami, T. Ajioka and N. Terada, "Chemical analysis of metallic contamination on a wafer after wet cleaning," in *IEEE Transactions on Semiconductor Manufacturing*, vol. 7, no. 4, pp. 447-453, Nov. 1994, doi: 10.1109/66.330284.

[5] D. Mereddy, Vijaya Rama Raju V and T. Sadula, "Smart Dual Axes Solar tracking," *2015 International Conference on Energy Systems and Applications*, Pune, 2015, pp. 370-374, doi: 10.1109/ICESA.2015.7503373.

ISSN: 2233-7853IJFGCN

[6] Keyur Patel1, Sanket Borole1, Ketan Ramaneti2, Atharv Hejib1 and R. Raja Singh1,IOP Conference Series: Materials Science and Engineering,2020, IOP Conference Series: Materials Science and Engineering, Volume 906, Virtual Conference on Advances in Electric Drives, Process Control and Automation 9 June 2020, India, Sweden and Denmark.

[7] M. Mazlan, R. R. W. W. I. R. A. Z. I. R. (2019). Design and Prototype Development of Automated Greenhouse with Arduino and (IoT) Application. International Journal of Advanced Science and Technology, 28(16), 437 - 446. Retrieved from http://sersc.org/journals/index.php/IJAST/article/view/1779

[8] Vineetha, K. V.; Sravani, K. Girija; Sailaja, B. V. S.; Guha, Koushik; Varma, P. Srinivas; Rao, K. Srinivasa, Design, simulation and performance analysis of MEMS based bio-sensors for the detection of cholera and diarrhea,Dec 2018, MICROSYSTEM TECHNOLOGIES-MICRO-AND NANOSYSTEMS-INFORMATION STORAGE AND PROCESSING SYSTEMS, 10.1007/s00542-018-3880-8.

[9] Mangalagiri V.K., Gujar N.S., Srinivasa Varma P. (2019), 'Digital automation in monitoring of life test setup of LED lamps using embedded systems', International Journal of Innovative Technology and Exploring Engineering, 8(6), PP.1630-1634

[10] Mangalagiri V.K., Gujar N.S., Srinivasa Varma P. (2019), 'Development of Embedded System for Monitoring of Life Test Setup of LED Lamp', 2019 IEEE 5th International Conference for Convergence in Technology, I2CT 2019

[11] Bade R., Ramana B.V., Dusarlapudi K. (2019), 'A six servo six DOF position controlled platform for sorting application', International Journal of Engineering and Advanced Technology, 8(4), PP.1215-1219.

[12] M Bala bhagya Sree, S Vasuvidutt, Pandian A(2020), "Piezo Hybrid Bicycle", Journal of Critical Reviews(2020), Volume 7, Issue no 9, pp-736-738, May 2020,ISSN Number: 2394-5125

[13] K Dusarlapudi, KU Kiran, MV Narayana, MV Suman, Flow based valve position control using NI my DAQ,2018, International Journal of Engineering & Technology, 7 (2.7), 955-957

[14] Narayana, M.V., Dusarlapudi, K., Uday Kiran, K., Sakthi Kumar, B., IoT based real time neonate monitoring system using Arduino, 2017, Journal of Advanced Research in Dynamical and Control Systems, 9(Special issue 14), pp. 1764-1772.

[15] Susmitha M., Seshi Reddy D. (2017),'Home automation rely on wifi',International Journal of Applied Engineering Research,12(Special Issue 1),PP.595-601

[16] Kalyan Dusarlapudi , V S P Chandrika Kota, Chinna Rao Annepu, M V Narayana,Accuracy Analysis Of An Ultrasonic Sensor Over An Open Channel Rectangular Notch For Rainwater Harvesting,2020, INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH ,VOLUME 9, ISSUE 01, JANUARY 2020 ISSN 2277-8616

[17] Chandrika Kota, V.S.P., Annepu, C.R., Dusarlapudi, K., Sreelatha, E., Tiruvuri, C.S.,"Smart approach of harvesting rainwater and monitoring using IoT",Journal of Advanced Research in Dynamical and Control Systems, Vol 12, issue 2,101-110, jan 2020

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