

Tinkercad: A Blended Teaching and Learning Tool

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Abstract: Tinkercad is a teaching and learning tool which could be used for electronic circuit implementation, software coding and 3D model designing. Technical skill sets improve by practicing designing and coding using Tinkercad simulation. The realistic view of the components gives real time feeling like students doing practical in laboratory. This paper will elaborate the design and development of basic electronic circuit, Arduino based circuit and a 3D model. An effective blended pedagogy which will help the students to understand the designing concept and its implementation. Tinkercad is an open-source free -ware simulation tool hence it's possible to every student to practice lab work with it. In the situation where physical laboratory work was not possible, Tinkercad provided a helping hand for Teachers and students to perform practical virtually.

Keywords: Tinkercad, Simulation Tool, Blended, Pedagogy, etc.

I. INTRODUCTION

To keep pace with the fast-growing technology blended teaching and learning tools play an important role in education. Tinkercad simulation tool helps Teachers and learners to overcome these obstructions and get acquainted to technology. Few important features of Tinkercad are:

1. Tinkercad is a free web/cloud-based software. It is used for 3D modeling, electronic circuits design & board simulation that helps beginners to start designing.
2. Tinkercad designs created are stored in your account and will be available in your account when login.
3. Tinkercad designs are automatically saved to your account as you work. Whenever you can return to your designs, you can tinker with them anytime from any internet enabled computer.
4. New Wire Options available in Tinkercad Circuits for example alligator.
5. Annotation i.e., Notes tool for explaining designs or provision for feedback.
6. Online Lessons and projects are available for learning and building your own projects.
7. Create your Tinkercad class by sharing class link or class code to join screen on home page.
8. Eleven built-in Libraries are available in Tinkercad as shown in figure 1.

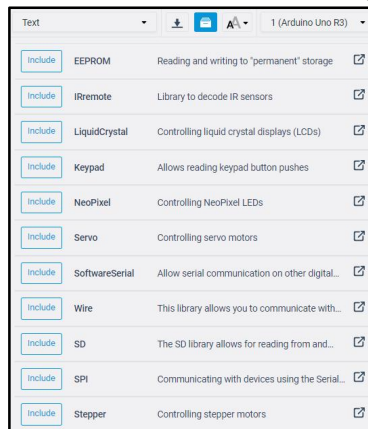


Figure 1: Eleven built-in Libraries available in Tinkercad

II. METHODOLOGY

This paper elaborates some examples of design and development of basic electronic circuits using Arduino, microcontroller and a 3D model. Basic circuit assemblies are also available like LED dimmer, multiple LEDs etc in Tinkercad. Sensors like temperature sensor, PIR sensor, tilt sensor, soil moisture & ultrasonic distance sensors are available for simulation.

Example 1: Relay interface with Arduino UNO board.

Components required are Arduino UNO, Function Generator, Multimeter, Transistor TIP120, Resistor-100 ohms, LED, bulb.

Algorithm for Relay interface with Arduino UNO board:

1. Assign Arduino UNO Digital pin no. 8 as output.
2. Turn ON relay to glow bulb.
3. Wait for 5 sec.
4. Turn OFF relay to switch OFF bulb.
5. Wait for 5 sec.
6. Repeat step 2.

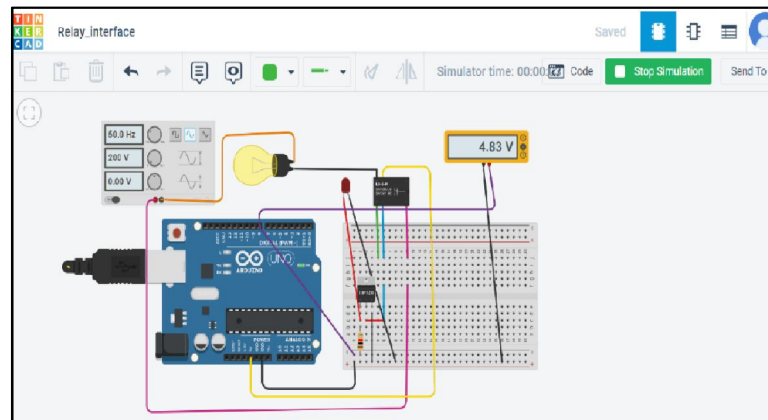


Figure 2: Example of Relay interface with Arduino UNO board.

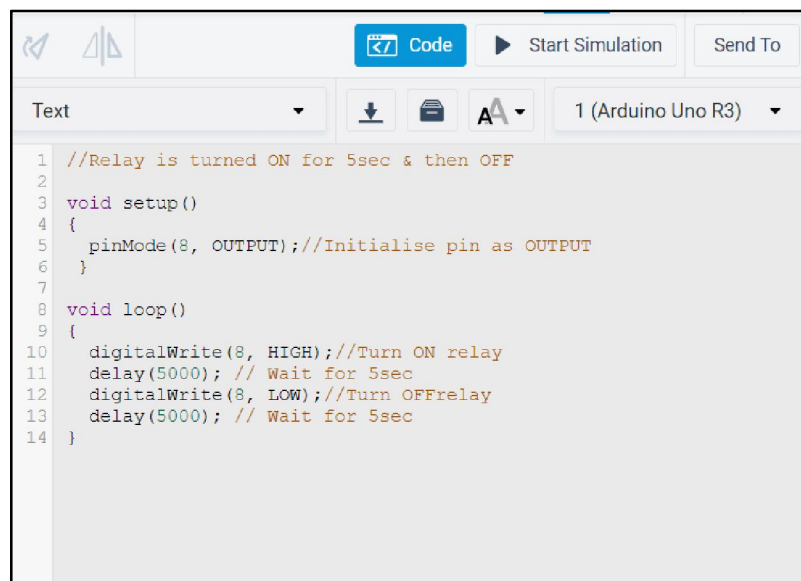


Figure 3: Code of Relay interface with Arduino UNO board.

Example 2: Robot hand using Arduino UNO board

In this example every individual Robot finger is controlled by servomotor. Robot hand is created using flex sensors. Flex sensor is a bend sensor which converts the motion of finger into corresponding change in resistor. Servo rotates each finger in Robotic hand.

Components required are: Arduino UNO, Servomotor, Flex sensors, Resistor-100 ohms and breadboard.

Algorithm for Robot hand using Arduino UNO board:

1. Assign fingers to servo.
2. Attach servo Thumb to Digital output pin no. 10 & servo Index finger to pin 11 of Arduino UNO.
3. Read information from flex attached to analog input.
4. Map flex output with servo minimum & maximum values.
5. Servomotor rotates.
6. Repeat step 3.

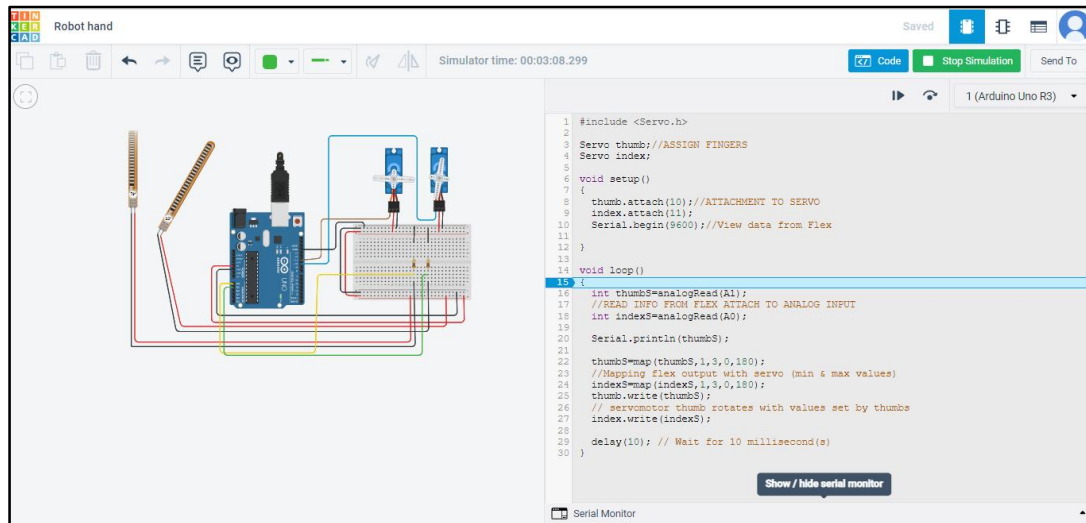


Figure 4: Example of Robot hand using Arduino UNO board with code.

Example 3: Temperature sensor with Arduino UNO

Components required are: Arduino UNO, LCD display, Temperature sensors TMP36, Potentiometer- 1 Kilo-ohms and breadboard.

LCD display is connected as shown in figure. Register select pin of LCD display is connected to D13 pin. Potentiometer is connected for contrast control.

Algorithm for Temperature sensor with Arduino UNO:

1. Include LCD library files.
2. Assign Liquid Crystal LCD pins (13, 12, 8, 9, 10, 11) for (rs, en, d7, d6, d5, d4) respectively and read/write pin to be grounded.
3. Set number of sixteen columns and two rows for LCD.
4. Measure Temperature by reading Temperature sensor input at Analog input pin A0 of Arduino UNO.
5. Mapping the ADC output: 0 to 1023 for 0 to 5 Volt range.
6. Select position of the cursor.
7. Display Temperature in Celsius.
8. Wait for some seconds.
9. Repeat step 4.

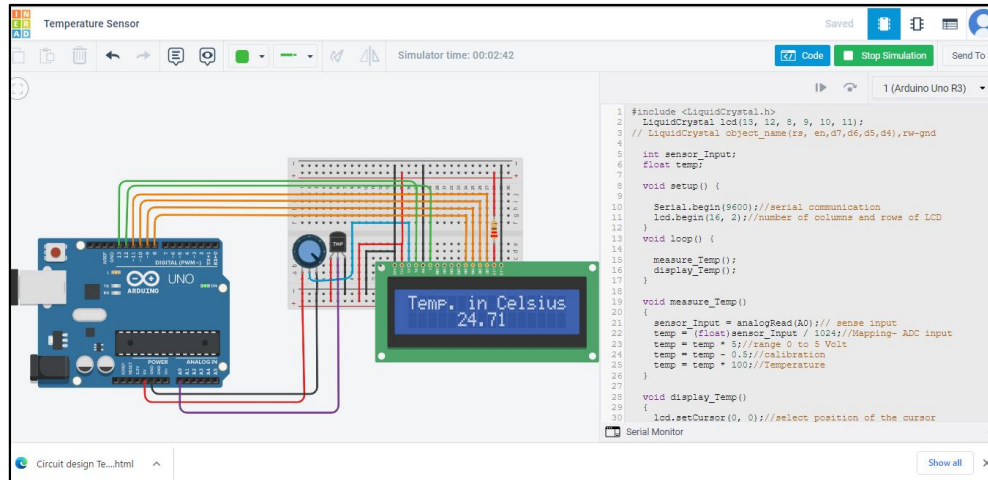


Figure 5: Example of Temperature sensor with Arduino UNO with code

Example 4: Microcontroller application

Microcontroller coding use two different approaches.

Block coding: Blocks code editor contains colored blocks that can be dragged and rearranged as per the program code.

Text coding: Text code is a regular style of coding.

Editor will automatically generate text-based code (C++) from blocks' code.

By switching the code view to (Blocks + Text) the logic of the block code is translated to C++ code.

Modifications made to the blocks code will instantly updated in the text view, providing insight into the logic and syntax of C++

Microcontroller boards– *micro:bit*

A pocket-sized computer with an LED light display, buttons, sensors and many input/output features, when programmed interacts with real world. The new micro:bit with sound adds a built-in microphone and speaker.

Coding & debugging- For micro:bit programming Python code or block coding is used. Debugging is done by adding breakpoints on the line number. When the cursor is placed on the variable its value in the program can be seen. To resume the simulation or step one line at a time a forward arrow button is provided on the upper side.

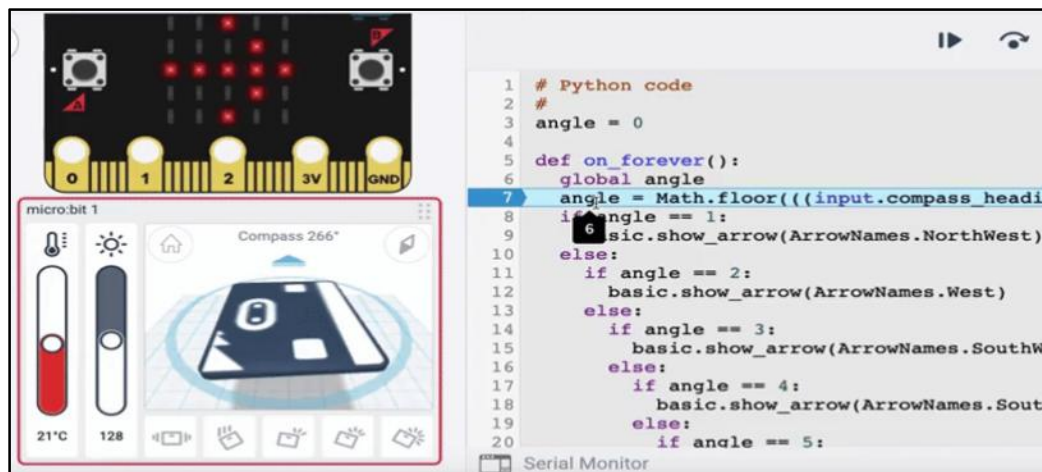


Figure 6: Example of Microcontroller board with python code

Example 5: 3D Modelling

Features available in Tinkercad for 3D modelling are

1. Shapes library with basic shapes, vehicles & machines, electronic parts, hardware, objects, structures & Scenery, creatures & characters etc.
2. Grouping, ungrouping, alignment, mirror etc.
3. Standard .OBJ, .STL, .glb file formats available for 3D printing.
4. .SVG file format available for laser cutting.

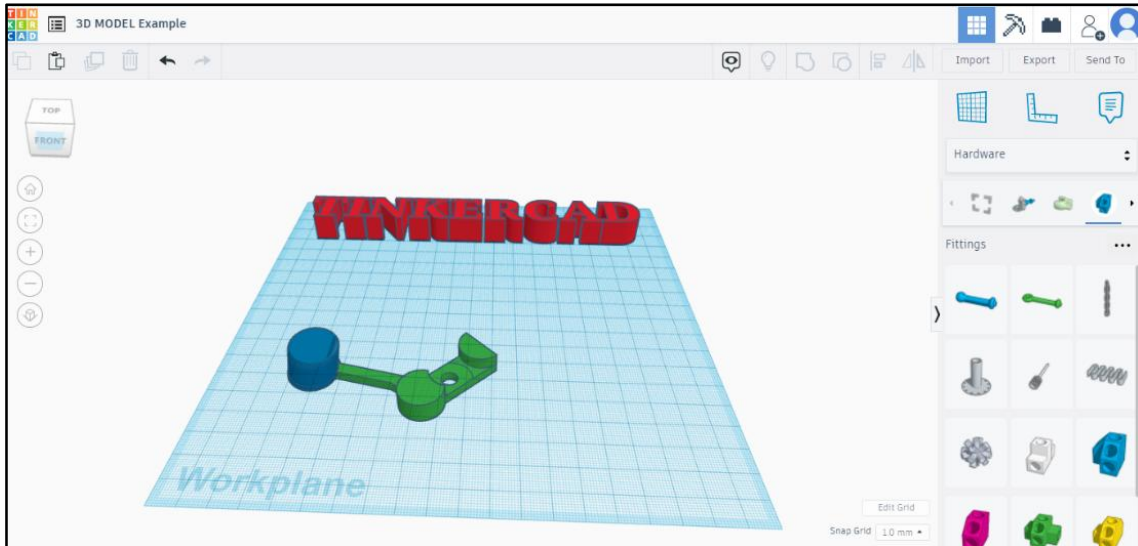


Figure 7: Example of 3D Modelling

Bridging 3D design & circuits: Electronic circuits can be embedded in 3D design for creating prototype or final product as shown in figure 8.



Figure 8: Example of Bridging 3D design & circuits

III. LITERATURE REVIEW

Selami et. al. [1] carried out study of students to find the use of Tinkercad to improve computational thinking skills and perceptions in computer programming education. They found students should be highly motivated by parents at home to increase frequency of using the software. Alex [2] in his book explained circuit simulation technique step by step in detail. Enjang et. al. [3] carried out study of online learning process of students and observed that students can independently or with some help can practice electronic circuits.

Radha et. al. [4] in his paper said the actual lab environment of Tinkercad simulation helps students to understand the concept. This simulation software is simple to work. Dr. Semin et. al. [5] in his research paper designed & developed Arduino based mobile application.

IV. RESULTS & DISCUSSION

In this study, Teachers & students are recommended to use Tinkercad software for electronic circuit learning, designing & creating.

This simulation software can be used for troubleshooting and 3D modelling for project work.

Tinkercad designs can be shared for public. By default, design in Tinkercad is considered as private. To share private designs between the users or students, design must be made first public to Tinkercad gallery. Then design can appear in Tinkercad Gallery search results. Public designs also include HTML code that you can use to embed your designs on a website.

V. CONCLUSION

Innovative teaching- learning methods should be used. Blended teaching- learning is the need of the education system. New simulation tools need to be explored. So, keep on discovering resources and technologies. Students should build skills by practicing and love learning.

ACKNOWLEDGEMENT

I appreciate the support from the Principal and Management of Y. B. Patil Polytechnic for motivating me for conducting various activities for both teachers and students to explore various options available in Tinkercad to help students effectively for designing the electronic circuits and projects.

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