Sri Indu
College of Engineering & Technology
UGC Autonomous Institution
Recognized under 2(f) & 12(B) of UGC Act 1956,
NAAC, Approved by AICTE &
Permanently Affiliated to JNTUH
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INSTITUTION'S
INNOVATION
COUNCIL
(Ministry of Education Initiative)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VBB enabled Projects using Arduino

STARTS ON March 12, 2021

SLOT-I REGISTRATION OPEN

Registration : Free

Course Duration : 12 Hours

Weekend Course (Friday & Saturday)

Invited Participants: Third Year ECE, EEE, CSE

Restricted to 25 Participants/Slot

Resource Persons: In-house Trainers

Coordinators	Convener	Principal
Dr.P.Mukunthan	Prof.K.Ashok Babu	Dr.G.Suresh

Contact: 9894145701

SRI INDU COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

HANDS ON TRAINING COURSE

ON

VBB Enabled Projects using Arduino

Date: From 12.03.2021 (3 Week Course, Only on Friday & Saturday)

SHORTLISTED STUDENTS

ATTENDANCE SHEET

S. No	Hall Ticket Number	NAME OF THE STUDENT	Week 1		Week 2		Week 3	
1	18D41A04H5	Pyarasani Karthik	Karthik	Karthik	Karthik	Karthik	Karthik	Karthik
2	18D41A04H3	Pusapati Narasimha Raju	P. Raju	P. Raju	P. Raju	P. Raju	P. Raju	P. Raju
3	18D41A04H4	Puttoju Ashrith Chaithanya	Chaithanya	Chaithanya	Chaithanya	Chaithanya	Chaithanya	Chaithanya
4	18D41A04G3	Pasula Aishwarya	Aishwarya	Aishwarya	Aishwarya	Aishwarya	Aishwarya	Aishwarya
5	18D41A04L4	Surepally Pavan	S Pavan	S Pavan	S Pavan	S Pavan	S Pavan	S Pavan
6	18D41A04J9	Sampati Archana	Archana	Archana	g Archana	g Archana	g Archana	g Archana
7	18D41A04J0	Rangineni Aparna	Aparna	Aparna	Aparna	Aparna	← A →	← A →
8	18D41A04F1	Narsapola Nishanth Reddy	N.Reddy	N.Reddy	N.Reddy	N.Reddy	N.Reddy	A.P.Reddy
9	18D41A04P2	R.Chandana	chana	chana	chana	chana	chana	chana
10	18D41A04A5	Konduri Madhukar	Madhukar	Madhukar	Madhukar	Madhukar	Madhukar	Madhukar
11	18D41A04H2	Poshanaboina Naveen Kumar	P. Kumar	P. Kumar	P. Kumar	P. Kumar	P. Kumar	P. Kumar
12	18D41A04A0	Kodamarthi Sai Rohith	Rohith	Rohith	Rohith	Rohith	Rohith	Rohith
13	18D41A0461	Deva Krishna Kanth	Krishna	Krishna	Krishna	Krishna	Krishna	Krishna
14	18D41A04P2	R.Chandana						
15	18D41A04F4	Pakala Sarayu	P.Sayu	P.sayu	P.sayu	P.sayu	P.suya	D.surya
16	17D41A0419	Bagannagari Sumanth Reddy	S.Reddy	S.Reddy	S.Reddy	S.Reddy	P.Smyl	P.Smyl
17	18D41A04E4	Mu_la Sai Preetham	Preetham	Preetham	Preetham	Preetham	Preetham	Preetham

S.No	Roll No	Name	Sign	Sign	Sign	Sign	Sign	Sign	Sign
18	18D41A04P4	Nannuri Ruchika Reddy							
19	17D41A0411	Aravilli Venkata Chakra Shree Harsha	Shreeharsha	Shreethruth	Shreethruth	Shreethruth	Shoushava	Shreethruth	
20	17D41A04D1	Maila Kondal Reddy							
21	18d41a0431	B Abhinav Reddy	B.Reddy	B.Reddy	B.Reddy	B.Reddy	B.Reddy		
22	17D41A0499	Kalluri Sandeep Reddy	Sandeep	Sandeep	Sandeep	Sandeep	Sandeep	Sandeep	
23	17D41A04A3	K Pavan Kumar	K.kumar	K.kumar	←A→	←A→	K.kumar		
24	17D41A04B7	Kotagiri Nitish	K.Nitish	K.Nitish	K.Nitish	K.Nitish	K.Nitish		
25	18D41A0497	Aavula Sairuthwik Vamshikar	Vamshika	Vamshika	Vamshika	Vamshika	Vamshika	Vamshika	
			(24)	(23)	(23)	(23)	(23)	(23)	

Coordinator

Convener

HOD/ECE

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Introducing Virtual Breadboard Windows App

The Virtual Breadboard (VBB) modern App for the Windows Universal Platform (UWP) uses the Fluent Design System modelled on the Windows Paint 3D App that we all know and love.

In VBB the main design area

(1) is a Design Sheet where you layout Virtual Breadboard circuits which can be virtualized by powering on the circuit (2). The menu (3) opens a navigation view where standard file dialogs along with examples, trainings and account management can be accessed. While designing the toolbar ribbon (4) selects the design mode which shows context sensitive tool panes in the right hand panel (5).

Main functional regions of the App:

1. Design Sheets : Are where you design your Breadboards
2. Power On : Power Up the circuit to start the interactive Virtualization
3. Menu : Open and save projects, find examples and take training and access your account
4. Tools Ribbon : Access the tools for editing and managing your project from the tools ribbon
5. Tools Pane : Tools from the Tools Ribbon are accessed from the Tools Pane

Avatar Hardware

Your real microcontroller is inserted into a Virtual Breadboard via an Avatar Hardware interface.

Your microcontroller cannot tell the difference between virtual or real.

Other real components can also be connected to your microcontroller creating micro-mixed-reality.

App Menu Navigation View

The Menu Navigation view slide out panel provides access to the file management, account, settings and other management features.
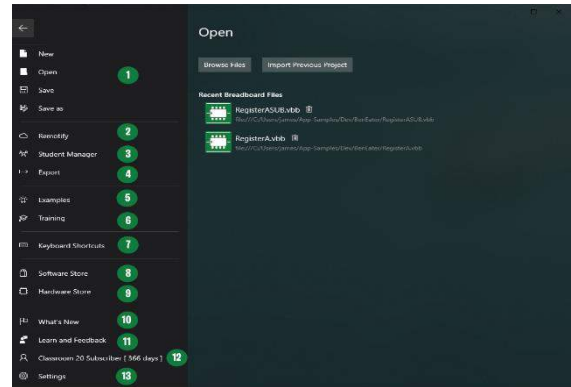
The platform workspace environment features:

1. File Menu : New, Open, Save, Save as file options
2. Remotify : Publish virtual hardware to the Cloud
3. Student Manager : Create and manage student accounts
4. Export : Export and exchange VBB designs in SVG and KiCad formats
5. Examples : Browse reference examples for quickstarting a project.
6. Training : Awards based training system for getting started.
7. Keyboard Shortcuts : Awards based training system for getting started.
8. Software Store : Make In-App purchases from the Software Store.
9. Hardware Store : Browse the available Avatar interface modules.
10. What's New : Displays the Splash Screen which contains news and quick access tutorials.
11. Learn and Feedback : Access Documentation, YouTube and CodeLab Tutorials and Forum.
12. Account : Account status and login.
13. Settings : Project wide settings and App information.

Files

Virtual Breadboard projects are stored in .VBB files. Standard file dialogs are used to open and save .VBB files.

New

Click New to create a New blank project. If you already have a project open you will be prompted to save the project before the New project is created

Open

Click Open displays the Open panel with tools to open existing project. If you already have a project

open you will be prompted to save the project before the existing project is opened.

1. **Browse Files** : Click to open a file dialog to locate .vbb files to open
2. **Import Previous Project** : Click to open a folder dialog to locate and import project folders from earlier versions of VBB
3. **Recent Breadboard Files** : A listing of recently used .vbb project files. Click a project from the list to open directly

Save

Saves the current project to the currently selected .vbb file. If this is the first time you are saving the project the Save as will be activate instead.

Save as

Click to open a Save File Dialog to provide a new name and location for your .vbb file and save to the new file.

Remotify

Remotify is a publishing system that enables virtual circuits to be published to the internet and played in a Browser.

You can think of Remotify as a Cloud File and Folder manager where the Files are VBB Projects and the folders are Groups of VBB Projects.

Remotify manager maintains a tree heirachy view of the Groups and Projects.

The basic procedure is

1. Create Group
2. Add Project to Group
3. Publish Group or Individual Projects in the group
4. Paste the publish Link to the browser

When publishing url link is copied to the clipboard which can be used in a Browser to Play the virtual hardware project

HTML5 WebPlayer

The WebPlayer is a lightweight Html javascript client that connects a Html5 Canvas renderer to a docker container instance of the .Net CORE version of the VBB runtime connected over SignalR. The docker container is hosted as an Azure container instance and spun up on demand per user session so all users have their own dedicated instances giving consistent scaleable performance for each user.

Despite being an economical approach there is a cost associated with hosting cloud sessions and hence the basic subscriptions covers development and casual personal use of the WebPlayer only. If useage grows beyond fair use a seperate usage based susbcription will apply.

HTML5 Canvas currently works on the latest versions of

- Chrome
- Edge

Published Group

When a group is published a url will be saved to the clipboard. The url can then be pasted directly to a browser or an alternate such as notepad. The url can then be shared by email or a link in a content management system. When the url is opened or pasted into a browser it will load the group access page   with the Name, Description and Thumbnail taken   from the group editor fields and the projects.

There are two types of Browser view

- Collections of Groups
- Collections of Projects

## Group Collections Viewer
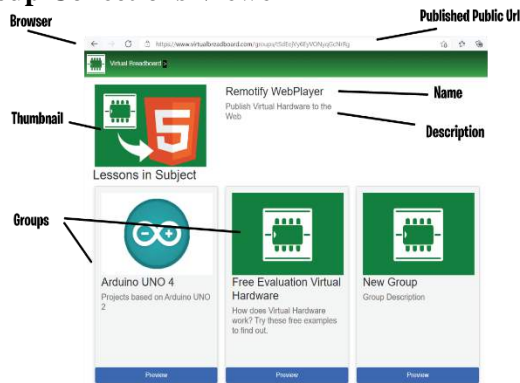
Project Collections Viewer
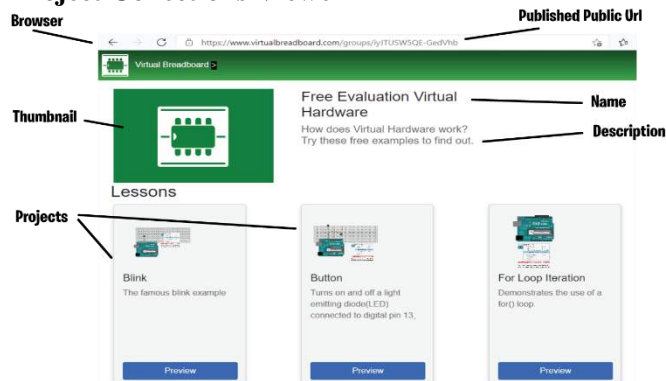
Published Project

When a published project is opened from a Group view or by directly pasting or linking the project url the project will load into a project Viewer. If this is the first project accessed in a browser session then a session container will be spun up which currently takes around 30 seconds. In the future standby containers will be used to reduce this intial spin up time. If when switching to a new project within the same session the browser uses can track the current session and reuses the same container. Hence there is no additional spin up time when switching between projects as long as the same browser window is used and standard navigate back button is used to navigate the groups collection heirachy. Each session has a time limit after which it will expire. This can depend on the user account.

Project Viewer Load
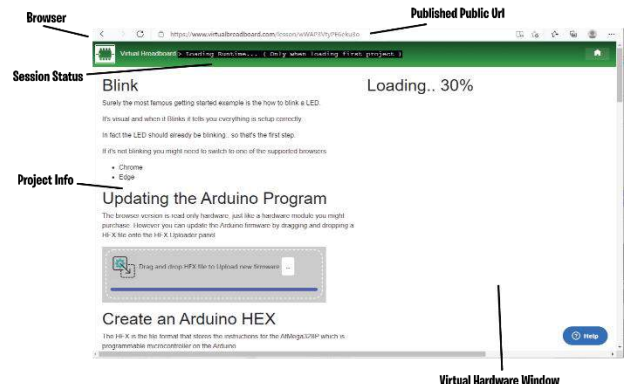
Project Viewer Run
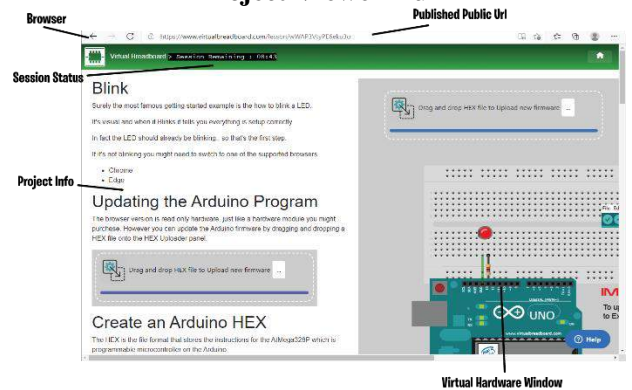
Remotify Manager Tools
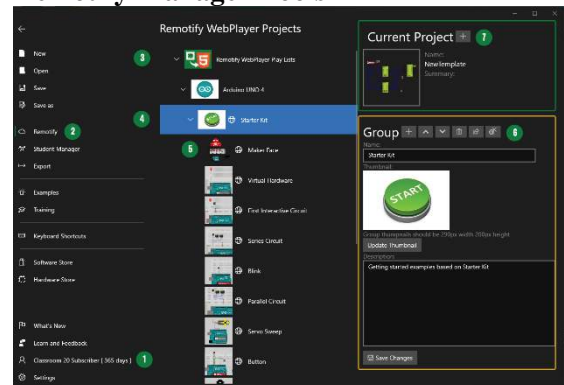
1. Subscription : A subscription and Virtual Breadboard account is required to activate Remotify
2. Remotify : Remotify is accessed from the Navigation View Menu
3. WebPlayer Play Lists : The root directory of the web group collections
4. Group : A Group is a collection of Groups or Projects
5. Project : A Virtual Breadboard Project stored in a Group
6. Group/Project Toolbar : The Toolbar of the currently selected Group or Project
7. Current Project : The VBB project currently open when Remotify Menu was selected

1. Subscription Status

To activate the Remotify Manager requires :

- PRO or CLASSROOM Subscription
- Virtual Breadboard Account

For more information about accounts see here : Account

If not activated the Remotify Manager will show the following message.
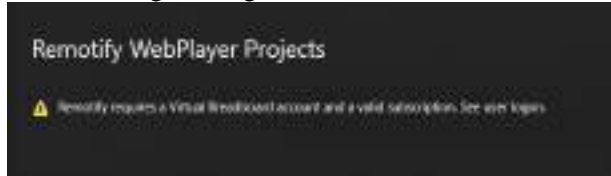
2. Remotify Menu

Remotify is accessed from the Navigation View Menu. This

3. WebPlayer Play Lists

The root remotify group contains all the Group or Project collections. There can be only groups or projects at the same level of the heirachy. The Name, Description and Thumbnail are not editable for the root remotify group.
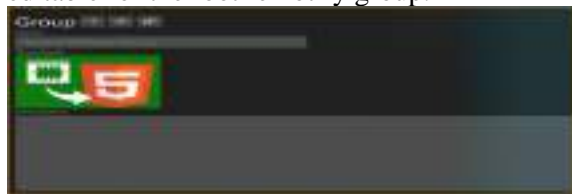
Icon	Function
+	Adds a new Group Child to the root directiory
(publish icon)	Publishes the project, making it public and copying a url link to the clipboard
(unpublish icon)	UnPublishes the project making it private and not visible in the browser

4. Group

A Group is a collection of Groups or Projects. When selected a group will be highlighted with a blue strip in the heirachy and the group information will be displayed in the Group pane.

5. Project

A Virtual Breadboard Project stored in a Group. When selected a project will be highlighted with a blue strip in the heirachy and the project information will be displayed in the Project pane.

6. Selected Group/Project Toolbar

6.1 Selected Group Toolbar

The Group definition is edited in the Group Pane. The Name, Description can be edited to be displayed in the Browser Group Viewer to inform the nature of the projects in the group.

The Thumbnail is also editable and must be a 290x200 png image.

Icon	Function
+	Adds a new Group as a child of this group.
^	Decrements the selected group order moving it up one place in the list
v	Increments the selected group order moving it down one place in the list
(trash icon)	Deletes the selected group if empty removing the group from the cloud.
(publish icon)	Publishes the project, making it public and copying a url link to the clipboard
(unpublish icon)	UnPublishes the project making it private and not visible in the browser
Update Thu	Opens a dialog to select an 290x200 png image to be the new thumbnail.
Save Ch	Saves the new group definition to the remotify cloud.

6.2 Selected Project Toolbar

The Project definition is viewed in the Project Pane. The Name, Description are copied over from the Info designsheet in the VBB Project. The remotify project can be opened and later saved directly to the remotify cloud making remotify a type of cloud drive for VBB projects. The toolbar tools are used to manage the visibility and membership of the project in it's group.
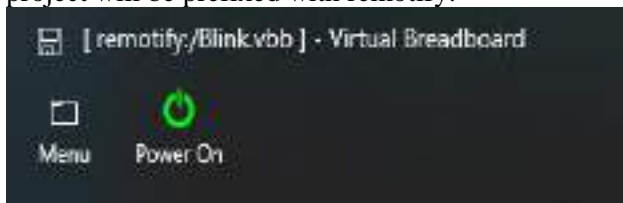
Remotify Project

Icon	Function
^	Decrements the selected project order moving it up one place in the list
v	Increments the selected project order moving it down one place in the list
🗑	Deletes the selected project removing it from the cloud store
↪	Publishes the project, making it public and copying a url link to the clipboard
⊕✗	UnPublishes the project making it private and not visible in the browser
↓ Open P	Opens the remote remotify project as the current project

Opening Remote Project
When opening a remote project the title of the project will be prefixed with remotify.

When a remotify project is saved it it will be updated directly in the cloud. In this way remotify acts as a cloud drive for VBB projects.

7. Current Project
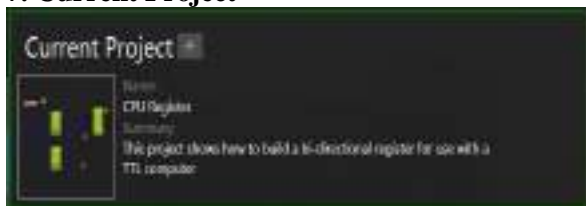
When navigating to the Remotify Manager there is a project currently open in the background. A snapshot of this project is shown in the Current Project pane. The Name and Summary are taken from the project information of the current project and the Thumnail is automatically generated from the active Breadboard. The Project tools are used to connect the project with a Remotify Group.

Icon	Function
+	Add Project to the currently selected group

Troubleshooting
- Firefox does not seem to work with the way VBB uses the Html5 Canvas at this time.
- Projects should be single Breadboard projects.
- A Group should contain only projects or groups but not both otherwise the web player will not function correctly.

Roadmap
- ESP8266 is not currently available - backend version needs to be updated.
- Connect Avatars to Remotify Browsers via RasPi Server to create remote labs

Student Manager
Classroom administrators use the Student Manager to create and manage Student Accounts. The task of the Student Manager is to enable an Adminstrator to register Student Accounts by following these steps.
1. Edit or import the list of Student Names
2. Set a password for all Students.
3. Click the Register Students Button
Notes:
- Student Names should be unique names.
- The password should be unique to your classroom.
- Student names and accounts can be changed and updated as required.
- Students logged on when registrations are updated will have to logon again.
- Only one student can be logged onto each student name at a time.

Student Accounts
Student Accounts are suitable for school use where there are often privacy concerns. A Student license only uses a nickname and is maintained by classroom administrator so there is no student information, email or microsoft account information stored with a Student Account. A Student Account has full access to VBB except with only a few restrictions:
Student Account Restricted Access:
- Student Manager

- Remotify Publishing
- CDK Publishing

Student Manager Tools
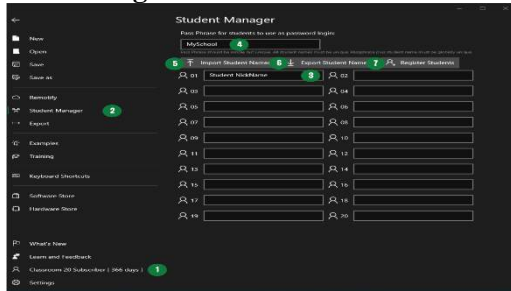
1. Classroom Subscription : A Classroom subscription is required to activate the Student Manager
2. Student Manager : The Student Manager is access from the Student Manager Navigation Menu
3. Student Names : The Student Manager maintains a list of editable student names representing a class
4. PassPhrase : A shared password is created by editing the password textbox
5. Import Student Names Button : Imports a list of student names
6. Export Student Names Button : Export the current list of students can be d using this button
7. Register Students Button : Create a Virtual Breadboard Student account for each named student with the shared passphrase

1. Classroom Subscription
To activate the Student Manager requires two accounts.
- Microsoft Classroom Subscription
- Virtual Breadboard Account

For more information about accounts see here : Account

If not activated the Student Manager will show the following message.

Microsoft Classroom Subscription
The Microsoft Classroom Subscription account manages the subscription information. There are 4 classroom subscriptions available to suit different class sizes of 10,20,30 and 60 students. These subscriptions are annual subscription and we have partnered with Microsoft using their In-App purchasing system to simplify the aquistion, invoicing, localised sales taxes and management of these licenses. When you start the Virtual

Breadboard App your account information is already known from your Microsoft Windows 10 Logon and so the subscription information is queried automatically using this account.

A classroom subscriber will have the CLASSROOM name shown in their Account stutus
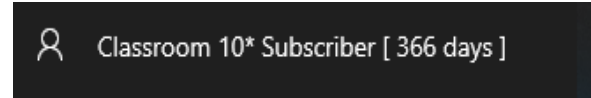
Note : There are actually 2 account required to work with the Student Manager so if only the subscription account is available '*' is shown in the status name to show the account is only partially activated.

Virtual Breadboard Account
The Virtual Breadboard Account manages the access to Virtual Breeadboard Cloud backend. The Student Accounts are registered in the cloud which enables students to logon from any location. For more information on creating a Virtual Breadboard account see : Account

When both accounts are registered your account status will display CLASSROOM without the '*' showing the CLASSROOM account is fully activated.
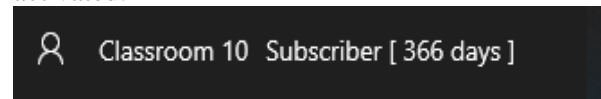
2. Student Manager
The Student Manager is access from the Navigation Menu.

3. Student Names
An editable collection of student names is managed by the Student Manager.
- Clicking a name will highlight the text ready for editing
- Use the Arrow keys to navigate between names

4. Pass Phrase
A single password is shared by all users. The Password should be longer than 6 letters and should be easy to remember but not super obvious.

5. Import Student Names
To make it easy to maintain class lists you can import a named list of students.
- Should be a .txt file
- One student per line
- If more students are in the list than are available in the subscription the list will be truncated.

6. Export Student Names
To make it easy to maintain class lists you can Export a named list of students.
- The file will be .txt file
- One student per line

7. Register Students
Registers the current list of Student names creating a unique account for each student.
If you have students names that are not unique or there is some other error then you will receive a warning.
If the registration is sucessful you will receive a success message.

VBB101
Contents:

- Interactive
  - Interactive Circuits
  - Push a Momentary Button
  - Toggle a Switch
  - Rotate a Potentiometer
- Junctions
  - Junction Mode
  - Place Junctions
  - Exercise : Power Up and Verify
- Links
  - Wires
  - Enter Wire Mode
  - Draw a Link
  - Change the Link Color
  - Exercise : Practice makes perfect
  - Reposition Link Corner
  - Reposition Horizontal Link Segment
  - Reposition Vertical Link Segment
  - Moving Links
  - Exercise : Reorganise Links
- Move
  - Moving Components
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  - Move Duplicate
  - Copy and Paste with ShortCut keys
  - Move Duplicate 2
  - Group Selection Append
  - Group Move
  - Power On First Customised Circuit
- NetLists
  - Adding a Netlist
  - Showing Hidden Nets
  - Edit netlist property
  - Exercise : Power Up and verify

- Nets
  - Adding a Net
  - Edit Net Properties
  - Add Existing Net
  - Copy and Paste Net
  - Show Nets
  - Exercise : Power Up and verify
- PowerOn
  - Powering On
  - Powering Down
  - Closing a Project
- Properties
  - Component Properties
  - Select Mode Toolbar
  - Select Component
  - Change Property Value
  - Select a Group of Components
  - Change Group Property Values
- Schematics
  - Schematics
  - Edit 'ID' property
  - Common 'ID' Common Netlist
  - Edit 'Layout' property
  - Exercise : Repeat the previous steps
  - Wire Up the Schematic
  - Exercise : 'Power Up' and verify
- Toolbox
  - Toolbox
  - Search for Component
 - Place Component

Interactive
Interactive Circuits
Virtual Breadboard circuits are interactive. Input components such as buttons, switches and potentiometers are used to provide user input to test and operate virtual circuits.
Push a Momentary Button
The momentary button is normally not connected contact switch. When you press the button a contact is made between pins on either side of the button completing a circuit while the button is held down.

Award : Power On the circuit then locate the momentary button. Press and hold it down for a few moments. The L.E.D will light up because the momentary contact switch completes the L.E.D circuit with the battery and resistor.
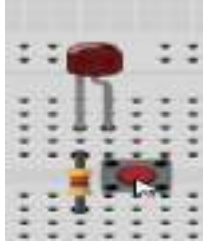
Toggle a Switch

A 3 pin switch has two possible configurations. It can connect the command center pin with the left pin or the right pin. When connected to one pin the other pin is disconnected or open circuit. The switch position toggles to show which pin is connected to the center pin.

Award : While Powered Up locate the Toggle Switch and click the component on the switch location. The position of the switch slider will toggle and the alternate circuit will be completed toggling which L.E.D is activated.
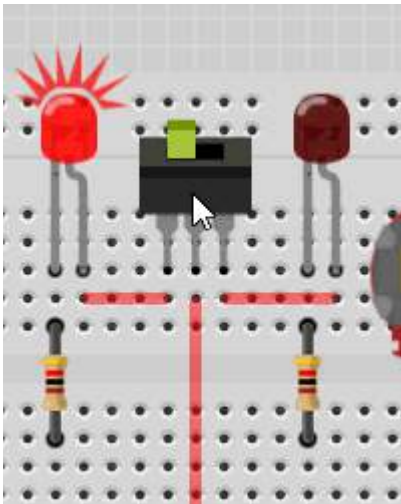
Rotate a Potentiometer

A potentiometer is a variable resistor which when you rotate the dial it's resistance changes which changes the output voltage of the central pin. Virtual Breadboard models the voltage output of the potentiometer voltage divider which can be read by instruments like the digital voltmeter and visualised by components like the L.E.D which are sensitive to analog voltage levels.

Award: While Powered Up locate the Potentiometer and press and hold the mouse down on the potentiometer dial. Rotate the dial around the center for the full range of voltage values. To receive this reward you need to exercise the full potentiometer range. You will see the L.E.D dim when the voltage is low and brighten when the voltage is high.
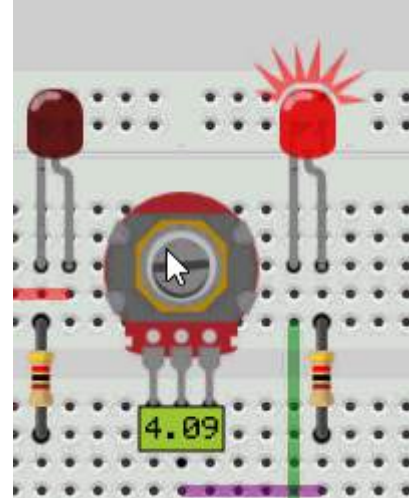
Advanced TIP: VBB is not an analog PSPICE simulator but instead models high level circuit behaviour. For example a PSPICE simulator will model the reduced L.E.D current and bandgap and deduce the L.E.D should dim but VBB models common circuit behaviours directly.

Junctions

Learn how to join links with junctions

Junction Mode

Links are drawn between component pins. However there is often the need to link multiple pins together on the same wire. You can draw multiple individual wires from pin to pin but you can also use junctions to simplify circuit layout and make it easier to understand what the connections are.

**Award**: Select Junction Mode from Wires ToolTab

Place Junctions

When in Junction Mode the cursor changes to a cross-hair and when the cursor is pressed a junction is placed at the cursor location. Junctions should be placed at the end point of a wire and a wire segment. This joins all the wires into a single wire.

Award: Place a junction at each of the 3 wire-t-junctions

Exercise : Power Up and Verify

When correctly placed the wire becomes a single wire leading from the DIP power source to the LED lights. All the LEDS should light up when the LED is in the 'on' position.
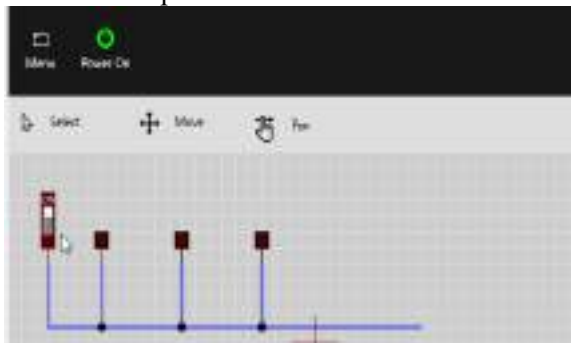

Wire Links
Wires

Wires link component pins to form circuits. Real breadboard 'wires' are usually coloured with plastic protection and are stripped back to wire only at the ends. Virtual Breadboard (VBB) wires are the also only active at the ends and snap to pins at either end. When successfully snapped the wire thickens slightly to give a visual clue the link has been successfully made.

Enter Wire Mode

Wire mode is a design mode and is set from the Wires tool tab. When in wire mode the cursor changes to a colored cross-hair and cursor actions draw wires.

Award : Select the Wires Tab and press a colored Wire Button to enter Wire Mode.
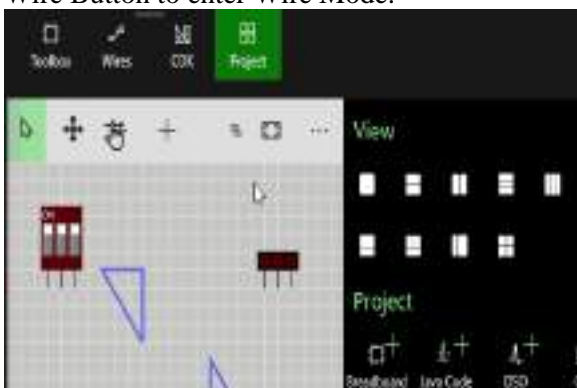
Draw a Link

A link is active only at it's ends but it can have multiple 'joint's along it's length to enable better layout organisation than just have a wire running from end to end. Links are drawing by clicking the joints with the left button then either **clicking the right mouse button to end** the link at the last joint **or double clicking** to make the current joint the final link.

Award: Draw a link from DIP pin 1 to LED pin 3 avoiding the obstacles with pin joints. To get this award you need to link the correct pins (DIP Pin 1, LED Pin 3).

Change the Link Color

If you change your mind about the color of the link you can change it by first selecting it either in move or select mode. When selected the links properties will be shown in the properties pane. Select a new color from color property.

Award: Select a link and change it's color.

Exercise : Practice makes perfect

Repeat the previous step drawing a link from DIP Pin 2, to LED pin 2. This time use the alternative link ending. So if you used right click method, use double click this time. Or if you used double click use the right click method this time.

Reposition Link Corner

When in Move Mode links can be moved around in several different ways. You can move joints, sections or move the link as a whole.

Award: Enter move mode and drag a corner of a link, move it around and then drop it back in place.

Reposition Horizontal Link Segment

If you drag a link section from the middle of the section instead of the corners the whole section will move. If the section is horizontal it can be moved vertically.
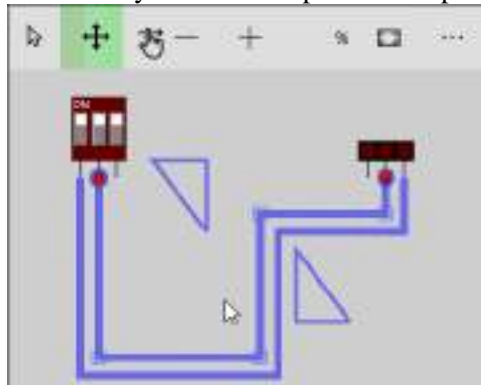
Award: Drag a horizontal link section up and down vertically and then drop it back in place.
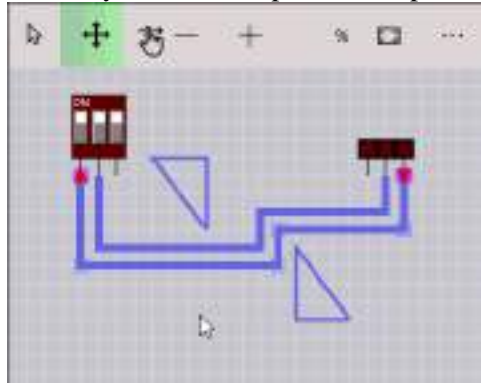
Reposition Vertical Link Segment

If the link section is vertical it can be moved horizontally.

Award: Drag a vertical link section left and right horizontally and then drop it back in place.


Moving Links

You can also move a link either as part of a group or as a single link by dragging with the **right mouse** button

Award: Drag the whole unattached link using the right mouse button and attach it the DIP pin 3.
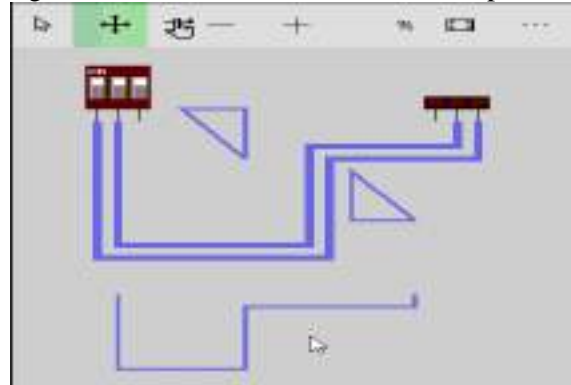
Exercise : Reorganise Links

A neatly organized layout is easier to understand. Practice your new skills to re-arrange the layout into a neater arrangement.
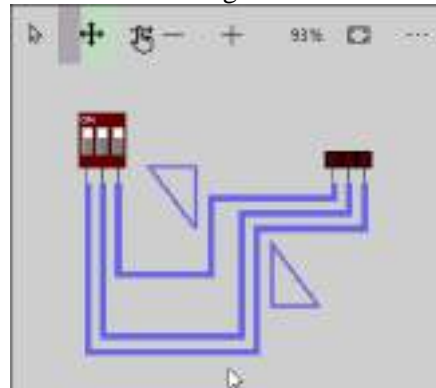
Moving Components
Moving Components

Virtual Breadboard (VBB) components can be moved around a design by dragging and dropping them while in **Move Mode** .

Select Move Mode

Move mode **(ShortCut V)** is one of the Editor Design Modes which can be selected from the Edit mode toolbar. Move Mode is used when you want to move components around.

Award: Enter move mode by selecting the move icon from the mode toolbar
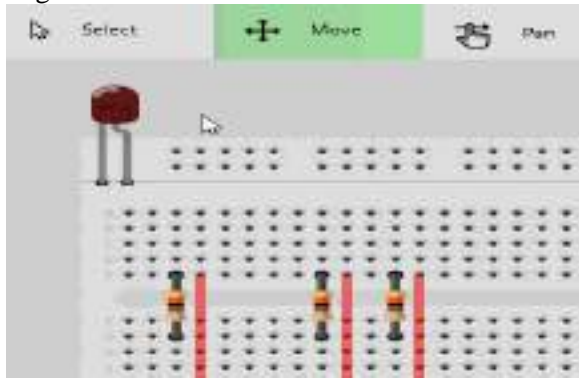

Move Component

When in move mode components can be dragged and dropped into position by pressing and holding and moving to the new location. VBB dynamically calculates the connections the component is making with other components and highlights the shared pin contacts. This is a useful visual guide for making sure components are correctly connected.

Award: Drag and Drop the L.E.D to the left most wire/resistor connection using the contact point

highlighting to make sure the LE.D is correctly aligned.

Copy and Paste

Use **Copy** and **Paste** to duplicate the currently selected breadboard elements. Copy copies to the Clipboard and Paste creates new versions of the copied components with a small offset to the originally selected elements and selects the newly created elements.

The Select toolbar contains functions that work with the currently selected elements including Copy and Paste.

Award: From the Selected toolbar first press Copy and then press Paste to duplicate the L.E.D
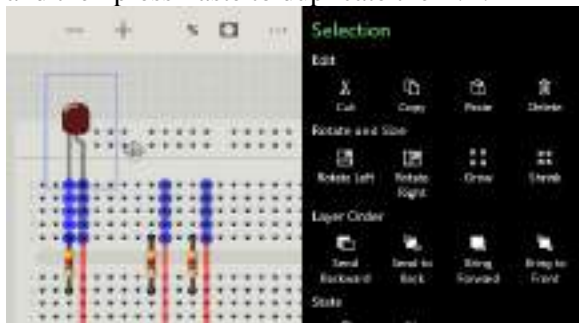
Advanced Tip: Copy stores the currently selection to the Clipboard and can be pasted to other Breadboards in the project or even Breadboards in other Project.

Move Duplicate

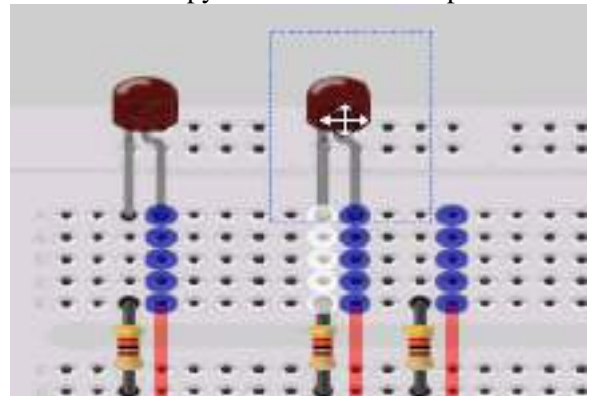Move the duplicate L.E.D to the next resistor/link connector point
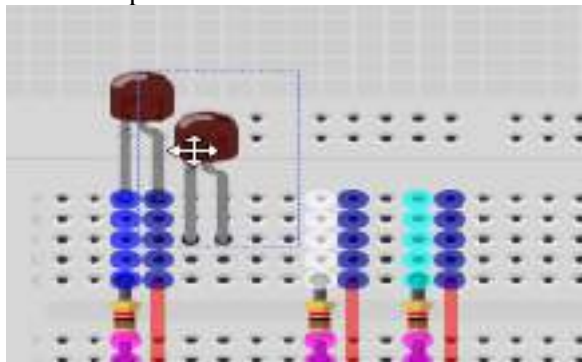
Copy and Paste with ShortCut keys

In the previous award the Copy and Paste functions were activated from the toolbar. The VBB App is designed with touchscreens in mind so all functions are available with touchable sized buttons.

However for keyboard users Copy and Paste have well defined shortcut keys in windows || Function || ShortCut | Copy | CTRL+C | Paste | CTRL+V | Cut | CTRL+X
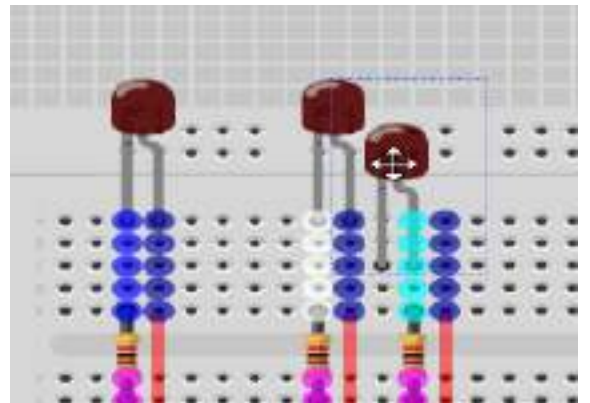
These shortcuts can often be faster to use when working in desktop environment.

Award: Copy and Paste the duplicate L.E.D using the short cut keys by first selecting it then using the CTRL+C to copy it and CTRL+V to paste it


Move Duplicate 2

Move the second duplicate L.E.D to the next resistor/link connector point inline with the first two L.E.D's


Group Selection Append

In an earlier award a group of components were selected by drawing a selection window around the whole group. You can also create groups by appending new components to the group by holding down the **SHIFT** key and then selecting other components to add to the selection group.
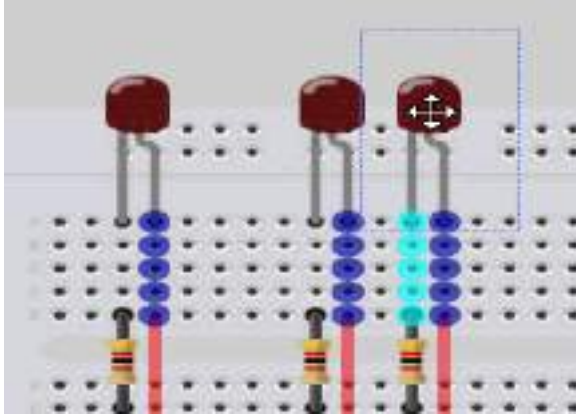
Group Move

Moving a group of selected elements can be much faster than moving components one at a time. To move the whole group hold down the **SHIFT** key and press and hold one of the selected components. You can then drag and drop the group. You can also use the **right mouse** button without the SHIFT key.
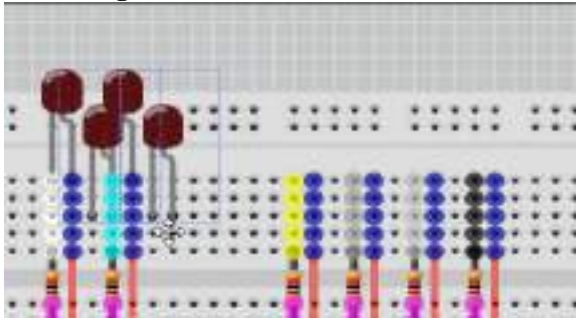
Power On First Customised Circuit

Repeat the previous steps 2 steps to practice the copy and moving components.

When ready you can then Power On 🔵 your circuit to test it
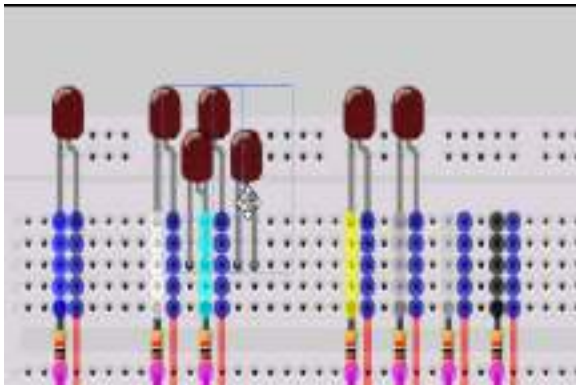
Schematics
Schematics

Schematics are abstract representations of physical components. It can be easier to understand how a circuit functions when represented in schematic format. Often schematics are used to describe a circuits netlist in a separate design step. In Virtual Breadboard (VBB) Schematics and Breadboard

components are merged into one design sheet creating hybrid designs where all the information about the design is in one place.

- Components with the same ID are linked
- Components have schematic/breadboard representations
- When a circuit has a schematic and breadboard component with the same ID the schematic component creates the netlist for the breadboard component.

Edit 'ID' property

When a component shares the same 'ID' property the pin the pins of both components are linked with virtual links.

Award : Edit the property of the LED to be D1

Common 'ID' Common Netlist

Components with the same ID share a netlist between them. To see this copy and paste a component with the same ID and Show the Nets to see the hidden links between the components.

Exercise: Duplicate LED D1 and Show Nets

Edit 'Layout' property

The Layout property determines which type of view of the component is rendered. So far you have only seen the Breadboard layout. Many components also support a Schematic layout.

Award: Select the duplicate LED and set it's layout property to Schematic

Exercise : Repeat the previous steps

Repeat the above steps for the Resistor * Edit the Resister property to be R1 Copy and Paste the Resistor Set the duplicate Resistor layout property to be Schematic

Wire Up the Schematic

When the schematic twins are wired to form valid circuits the matching Breadboard component twin is also wired with the same netlist.

Award: Snap the schematic elements together to form a powered LED circuit

Exercise : 'Power Up' and verify

At runtime only the Breadboard component is activated. The schematic component can be used to create an understandable netlist but it does not participate in the runtime circuit.
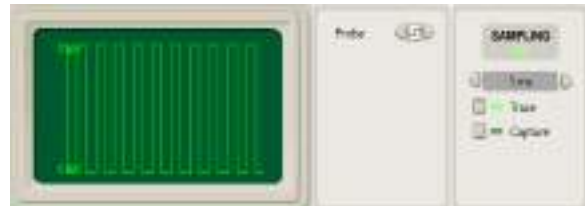
Note: One advantage of this approach is the physical Breadboard components can be placed anywhere without the confusion of connecting wires running all over the place.

Exercise: 'Power Up' the circuit and verify the LED brightens as powered by the virtual links.

DSO Basics

The **Digital Storage Oscilloscope** (DSO) is an essential tool for visualising and analysing circuits. In this training you will learn the basic steps of adding a DSO to your project and linking it to a probe.

The DSO Design Sheet

The DSO has two elements, the DSO design sheet and logic probes. The DSO design sheet is used to visualise the signals and configure the triggers and timebase view parameters. Probes are Breadboard components and are inserted into Breadboard circuits to capture signals and are linked to the DSO to send and visualise the captured signals.
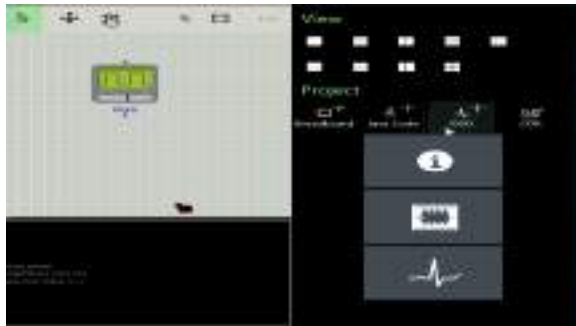
Award : Add a DSO Design Sheet to the project

Viewing the DSO

Like all Design Sheets the DSO needs to be dragged and dropped into a view pane to actually view it. This allows different configurations of circuits and instrument views to be created and easily switched between.

Award : Drag and Drop the DSO Design sheet into the bottom view panel

Attaching a probe

To capture signal data to display in the DSO you add one or more probes to the circuit.

Award :Add a probe and link it to the frequency generator

Power On to start tracing

The default mode is Trace Mode which continuously captures signals with the current timebase settings. The signal sampled will be the signal shown. Without a trigger there is no specific event that starts the sampling and the signal will appear to jitter.


A Trigger is a specific event that the sampler waits for before it begins to sample the signal. The effect of this is to place the signal in known location on the screen allowing visual comparison with previous signals better suited for detecting signal changes.

Triggers are a property of the probes. When powered up the probes in the Breadboard are scanned and added to the DSO Triggers panel. These triggers are logically AND'd together to create a single filter trigger event

Trigger	Event	Description
	Don't care	Not used in filter

Trigger	Event	Description
	Is LOW	True if this signal is LOW
	Is RISING	True if this signal is Rising Edge
	Is HIGH	True if this signal is HIGH
	Is FALLING	True if this signal is Falling Edge

Award :Change the Trigger to Rising Edge to stabilise the signal
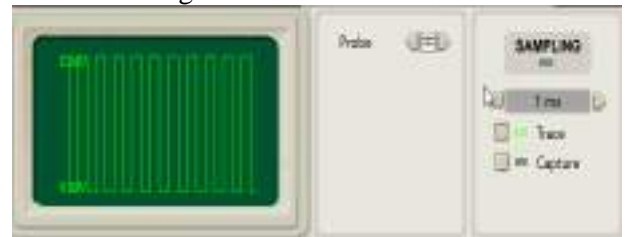
Setting the Timebase

The Time base is the amount of time shown by each grid unit in the DSO display. Changing the Time base has the effect of zooming in and out of the signal.

Award :Change the Time base zooming the display in and out

Signal Analysis

The DSO is used to sample and display signals to assist in circuit analysis and troubleshooting. For example you can use it to visualise and measure the frequency generated by a frequency generator.

Exercise : Change frequency by sliding the slider of the frequency generator and visualise the signal changes in the DSO