

by Innovations in Education

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**micro:GUI Overview**

This specification defines a **'Graphical User Interface'** or '**GUI'** for the **BBC micro:bit** which acts like a simplified version of the GUI used on most Smart Phones.It uses **Buttons A & B** on the **micro:bit** as '**User Input'** and the **5x5 LED Matrix** on the **micro:bit** as the '**Display'**. One LED acts as the **'Cursor'** and the LEDs along the bottom row act as the **'Apps'** thus creating a **'micro:GUI'.** The specification shows how it is possible to create an intuitive **micro:GUI** within the constraints of the limited controls and display resolution available on the **micro:bit**. The **micro:GUI** could for instance allow multiple programs, known as '**micro:Apps'**, to reside in a single Hex file with the **micro:App** 'launched' using the **micro:GUI**.

Furthermore, the fact that the **micro:GUI** can function with limited controls and limited display resolution lends itself to being adapted to use other forms of **'User Input'** and other forms of **'Display'**. For example, the **'User Input'** could be by **Tilt/Shake Control**, **Headphone Button Control**, **Joystick Control** or **Voice Control** and the **'Display'** could '**Auto Rotate**' or be an '**Audio Display**'.

The primary purpose of the **micro:GUI** is for ***education***. A '**Basic**' **micro:GUI** implementation could be coded in **Block.** It could be incorporated into computing lessons to helpstudents understand the concepts of a **Graphical User Interface** and give students the opportunity to code their own **micro:GUI.** In doing so students wouldlearn how to:-

* **write code** to monitor inputs from the **micro:GUI Navigation Controls**
* **move** a '**micro:Cursor'** in response tothe **micro:GUI Navigation Controls**
* **write code** for one or more **'micro:App'** programs
* **'install'** one or more **micro:App** programs on the **micro:GUI**
* **display** a **'micro:Icon'** whenever the **micro:Cursor** is on a **micro:App** **LED**
* **'launch'** their **micro:App** on a **micro:bit** using their **micro:GUI**

**micro:GUI specification Version 1.0** covers '**Basic**' **micro:GUI** functionality. Future versions will add '**Advanced**' **micro:GUI** features, some of which may require coding in **JavaScript** or **Python**.

**micro:GUI Display Overview**

The **micro:GUI** display has 4 elements:-

1. **'micro:Cursor' LED**
2. **'micro:App' LEDs** along the **Bottom Row**
3. **'micro:Icons'** in the **Centre** of the Display
4. **'micro:Option' LEDs** along the **Top Row** ('**Advanced'**)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **micro:Cursor** |  | **micro:Apps** |  | **micro:Icons** |  | **micro:Options** |  |  |
| **C** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **T** | **H** | **J** |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  |  |  |  |  |  | **0** | **1** | **2** | **3** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

The **micro:App LEDs** along the **Bottom Row** can be seen as the equivalent of the fixed App Icons along the bottom of most Smart Phone displays.

The **micro:Option LEDs** along the **Top Row** can be seen as the equivalent of the menu items along the top of most desktop PC programs.

**micro:GUI Display LEDs**

Each Display LED is set to one of 5 states:-

**LED Off [ ]**

**LED On [ ]**

**LED Half On** **[ ]** (**Advanced**)

**LED Slow Flash [C]** (approx 1 second ‘on’/1 second ‘off’) (**Advanced**)

**LED Fast Flash [F]** (approx 0.5 seconds ‘on’/0.5 seconds ‘off’) (**Advanced**)

**PushButton Navigation Controls**

**micro:bit PushButtons A, B** and **Reset** are used to **navigate the** **micro:GUI**.

Used with a ‘**Short Press**’ gives 4 '**Basic**' **micro:GUI Navigation Controls**:-

**Button ‘A’ – Short Press <A>**

**Button ‘B’ – Short Press <B>**

**Button ‘A+B’ – Short Press <A+B>**

**Reset Button <Reset>**

**'Basic' micro:GUI - Navigation Controls**

**Button 'A'** is used to move the ‘**micro:Cursor’** in the **Y-axis** **↓**

**Button 'B'** is used to move the ‘**micro:Cursor’** in the **X-axis** **→**

A **Short Button 'A' press** **<A>** is used to move the **micro:Cursor Down** **↓** one LED to (0,1) then to (0,2),(0,3),(0,4) and ***back to*** (0,0).

A **Short Button 'B' press** **<B>** is used to move the **micro:Cursor Right** **→** one LED to (1,0) then to (2,0),(3,0),(4,0) and ***back to*** (0,0).

A **Short Button 'A+B' press** **<A+B>** is used to '**Launch'** a **micro:App.**

A **Reset Button press** **<Reset>** is used at any time to **Return to the Home Screen** and **Close any micro:Apps.**

**'Basic' micro:GUI - Home Screen**

At **Power Up**, **Reset** or on '**Return to Home Screen'** the **micro:bit** displays the '**Home Screen'** with available **micro:App LEDs** along the bottom of the display and the '**micro:Cursor**' **[C]** in the top-left of the display - **LED (0,0)**. For a **'Basic' micro:GUI** implementation the '**micro:Cursor'** **[C]** would *not* **'Slow Flash'**. It would just be **'On' [ ]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **C** |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **1** | **2** | **3** | **4** |  |

At ***any time*** a **Reset Button press** **<Reset>** returns to this **Home Screen**.

**'Basic' micro:GUI - Cursor Navigation**

At **Power Up**, **Reset** or **'Return to Home Screen'** the **micro:Cursor** **[C]** appears in the Top Left **LED (0,0)** position.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **C** |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

**Button 'B' – Short Press <B>** moves the '**micro:Cursor'** one LED **Right** **→** in the **X-axis** to **LED (1,0).**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **C** |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

A subsequent **Button 'A' – Short Press <A>** moves the '**micro:Cursor'** one LED **Down** **↓** in the **Y-axis** to **LED (1,1).**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | **C** |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

The **micro:Cursor** **[C]** '**Wraps Round'** from **Right-to-Left** and **Bottom-to-Top** of the Display, hence...

When the **micro:Cursor** **[C]** is moved toan LED in the **Right Column** i.e. LED (4,Y) a **Button 'B' – Short Press <B>** moves the **micro:Cursor** back to the **Left Column** i.e. LED (0,Y) like this:-

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **C** | **>** |  |  |  |  |  |  | **C** | **>** |  |  |  |  |  |  | **C** | **>** |  | **C** | **>** |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | **B** |  |  |  |  |  |  | **B** |  |  |  |  |  |  | **B** |  |  |  |  |  |  | **B** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

When the **micro:Cursor** **[C]** is moved to an LED on the **Bottom Row** i.e. LED (X,4) a **Button 'A' – Short Press <A>** moves the **micro:Cursor** back to the **Top Row** i.e. LED (X,0) like this:-

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **C** |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **˅** |  |  |  |  |  |
| **A** | **C** |  |  |  |  |  | **A** |  |  |  |  |  |  | **A** |  |  |  |  |  |  | **A** |  |  |  |  |  |  |
|  | **˅** |  |  |  |  |  |  | **C** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  | **˅** |  |  |  |  |  |  | **C** |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **˅** |  |  |  |  |  |  |  |  |  |  |  |  |

Navigated in this way the **micro:Cursor** **[C]** can be ***moved to*** ***any location*** on the 5x5 LED matrix ***with a*** ***maximum of 8 Button Presses***.

**'Basic' micro:GUI - micro:App LEDs**

**micro:Apps** are indicated by the LEDs along the bottom of the display. So, for instance, if there were **4 micro:Apps** 'installed', the **Home Screen** would haveLEDs (0,4),(1,4),(2,4),(3,4) '**On**' as shown below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **C** |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **0** | **1** | **2** | **3** |  |

If **micro:Apps** are numbered in any documentation, the numbering should be ***from 0 upwards*** to match the **LED Column Number** relating to the location of that **micro:App’s LED** on the display.

**'Basic' micro:GUI - micro:Icons**

Moving the **micro:Cursor** **[C]** onto one of the **micro:App LEDs** brings up the associated '**micro:App Icon'** (or '**micro:Icon'**) on the display. **micro:Icons** could be things like:-

**Image.HEART**

**Image.DIAMOND**

**Image.HAPPY**

...etc from the MicroPython images library, or any other user configured Icon. As an example, if **micro:App(0,4)** uses the **SMALL\_DIAMOND** **micro:Icon**, when the **micro:Cursor** **[C]** is moved to **LED(0,4)** the **SMALL\_DIAMOND** would appear on the display like this:-

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **C** |  |  |  |  |

Note that to help the **micro:Icon** stand out and to simplify the coding, the **micro:App LEDs** and the **micro:Cursor** **[C]** **LED** can be ‘**Off**’when a **micro:Icon** is displayed.

**'Basic' micro:GUI - Launching a micro:App**

When the **micro:Cursor** **[C]** is on a **micro:App LED** and the **micro:Icon** is displayed, a **Short Button 'A+B' press** **<A+B>** '**launches'** the **micro:App.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **C** |  |  |  |  |

Once a **micro:App** is running the **entire display** is available for use by the **micro:App**.

**'Basic' micro:GUI - Closing a micro:App**

A **Reset Button press** **<Reset>** is used to close the **micro:App** and return to the **Home Screen.**

**---------------------------------------------------------------------------------------------------------**

**Open Specification**

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**Change History**

**V1.0** – **First 'Published' Version** specifying '**Basic**' **micro:GUI** functionality - **20th Jan 2018**