micro:bit to mega:bit

A TEACHING TOOL TO ENHANCE COMPUTING EDUCATION IN SCHOOLS

INTRODUCTION

- **Project goal** - To design and build a mass producable teaching aid for schools to help with incorporating micro:bit into computing lessons.
- **Current Problem**- The micro:bit is a pocket-sized handheld computer with a programmable LED display. While the small micro:bit is great for coding, teachers find it difficult to demonstrate student's work to the whole class.

BACKGROUND

Our client, **Micro:bit Educational Foundation,** is a not-for-profit organisation that created the micro:bit to encourage digital creativity and develop a new generation of tech pioneers.

1 Million Students | 22 Countries

It is rapidly expanding globally and being used in diverse settings such as refugee camps in Greece.

CLIENT CRITERIA

While designing the mega:bit, important client criteria and requirements had to be taken into account in order to make a device that is easy to handle for the teacher and is suitable for use in schools.

1) Ergonomic Design
2) Easy to Use
3) Safe
4) Reliable
5) Sustainable
6) Cost-Effective

SOLUTION

Display: The mega:bit replicates the form factor of the micro:bit with a 5x5 LED display, two push buttons and edge connectors at the bottom, but is much larger allowing the whole class to see the operation of the code.
Whenever there is a change in the LED display of the micro:bit, the larger LED matrix of the micro:bit is updated via I2C communication.

Seamless Integration: The student's micro:bit is plugged into the top of the mega:bit without the need for any additional soldering or coding from the user's side which allows for easy use.

Detection of Micro:bit: A "handshake" between the mega:bit and micro:bit allows detection for when a micro:bit is plugged in.

Battery Indicator: Features such as battery level indicators and a reset button are also present for convenience.

</> Software

Data Transfer Methods

1. I2C option – use micro:bit's I2C serial interface to connect mega:bit as a slave device
2. Accessibility pin option – Use pin reserved for transfering data using UART

Result: I2C chosen as it is simple and effective. Other I2C devices can still be connected in parallel

I2C Implementation

1. Alter the print functions in the DAL to include mega:bit display print code via I2C
2. Take into account the mega:bit's LED matrix driver dimensions by coding correct image bitmaps
3. Mega:bit LED matrix updated every time there is a change in the micro:bit's display

Result: Single letters can be displayed on matrix

Animation Mode

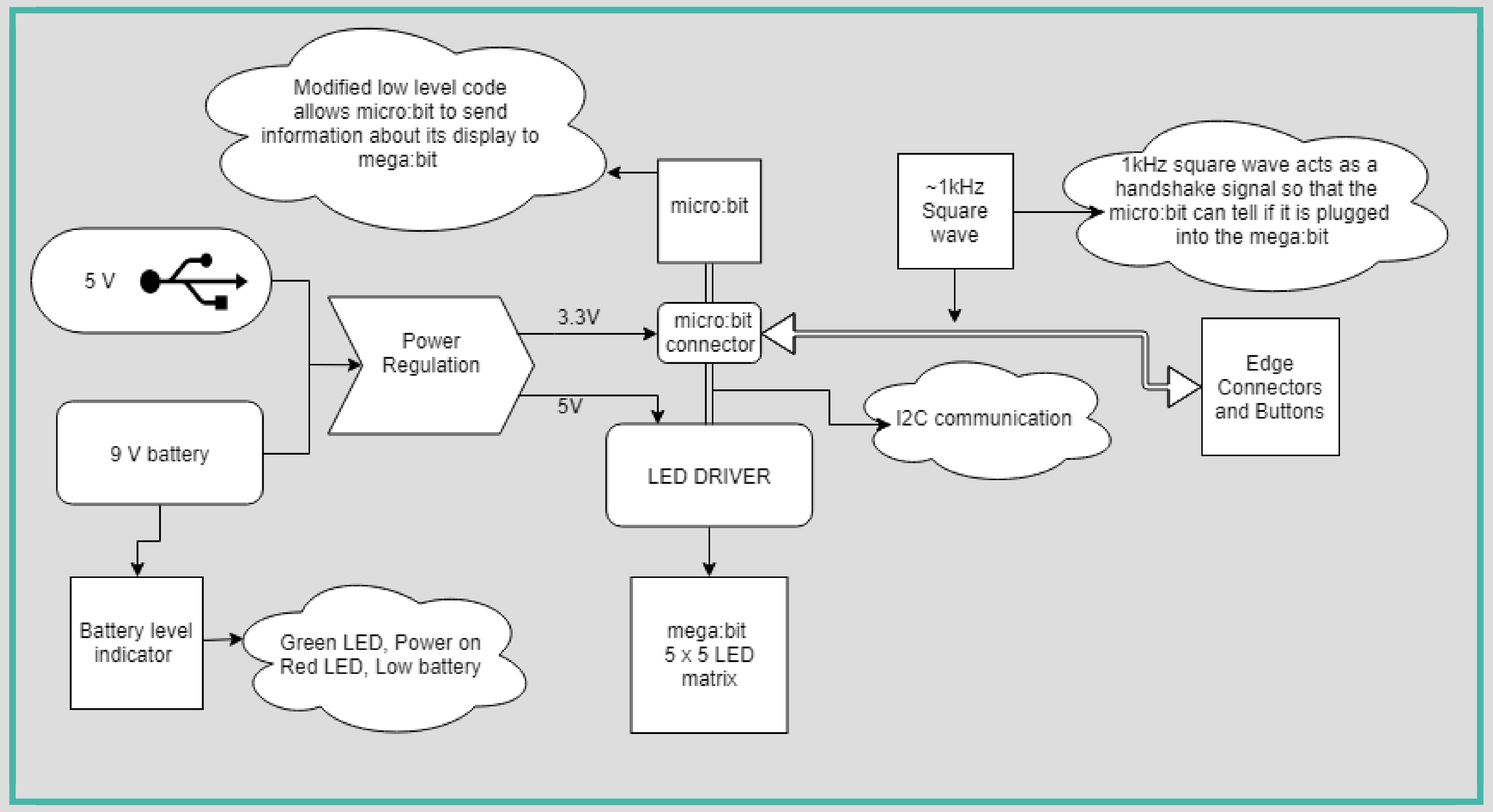
1. Alter animation mode in the DAL to allow for functions such as scroll and rotation of text.
2. Enable control of individual LED brightness on the mega:bit

Result: All characters, images and scrolling of text can be displayed on the mega:bit with specified brightness

micro:bit Detection

Use accessibility pin to detect when micro:bit is connected with a predefined signal that the micro:bit searches for on startup.

Block Diagram



Stage 1 — Stage 2 — Stage 3 — Stage 4 — Final Product

Test I2C Functionality

62 x 57mm PCB size, 3 mm LEDs

- 90 degree micro:bit edge connector
- LED matrix controlled by LED driver
- Power supply: **5V USB** followed by 3.3V linear regulator

Powering Options

100 x 74mm PCB size, 8 mm LEDs

- Added possibility to choose between USB and batteries.
- **9V battery** - 5V linear regulator +3.3V linear regulator
- **2 x 1.5V battery** - boost to 5V +3.3V linear regulator

Individual Brightness

96 x 66mm PCB size, 10 mm LEDs

- 2 LED PWM drivers to enable LED brightness control
- **4 x 1.5V battery** - buck to 3.3V

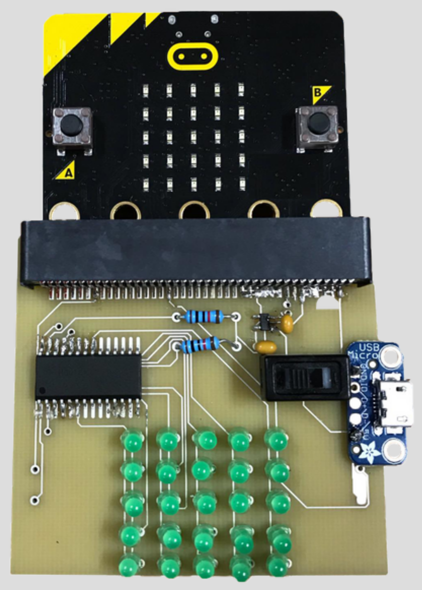
Final PCB Design

Final 100 x 120 PCB, 10 mm LEDs

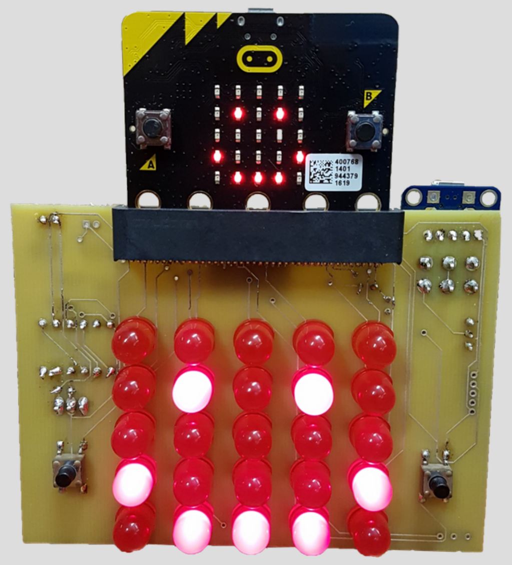
- More powerful LED driver, able to drive up to 144 LEDs and provide individual brightness
- **USB or 9V Battery power** = Buck 3.3V, linear regulator 5V
- Battery indicator

mega:bit

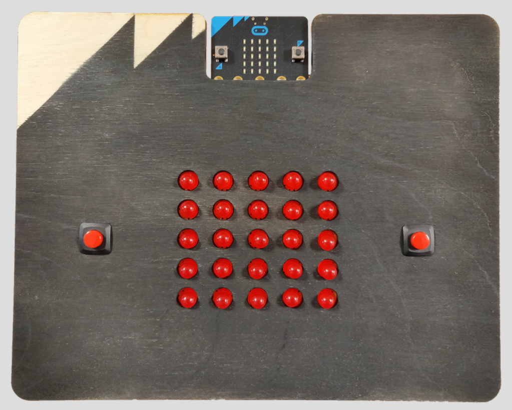
- Plastic Front & Back Case
- PCB
- Assembled by the end user with simple screws
- Instruction Manual included



Rev. 1

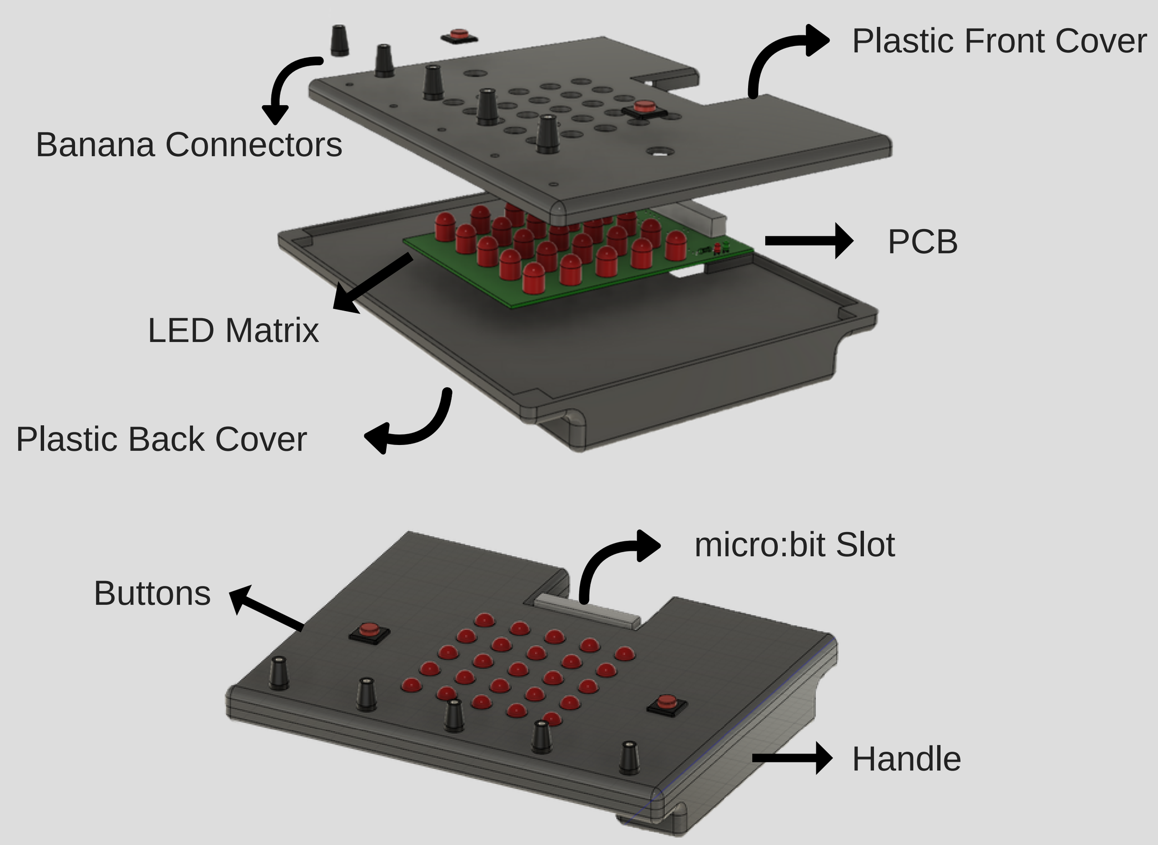


Rev. 2



Physical model

Prototype



Hardware

PRODUCTION

mega:bit will be mass-produced in two parts: a PCB and a plastic outer casing. A medium sized PCB is used as it is low cost in large numbers. To ensure robustness in a classroom environment, the casing will conceal and protect the electronic components from droppage and static.

Unit Price	Initial Volume	Potential Market
£50	5000 units	100k units

The mega:bit will be released in batches in the UK first. It will then expand globally as the micro:bit community grows.

FUTURE WORK

Haptic Feedback: Replacing the LED matrix with tactile feedback to enable visually impaired students to use the micro:bit
RGB LEDs: Switch between colours of the LED matrix for improved learning experience
Foldable Handles and stand: For easy use and storage for teachers
Changing the I2C address: Enable usage of all peripherals without possibility of I2C addresses conflicting

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