

Robotic Puppet with micro:bit

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1. Materials Checklist

Hardware & Electronics:

- ☐ **Micro:bit V2** (One per group; V2 is preferred for its built-in speaker and improved sensors).
- ☐ **USB Data Cable** (For programming and model uploading).
- ☐ **Battery Pack (AAA)** (To make the puppet mobile for the performance).
- ☐ **Laptops/Chromebooks** (With internet access for MakeCode and the ML-Machine tool).

Crafting & Engineering Materials:

- ☐ **Main Structure:** Cardboard boxes (various sizes), paper cups, or thick cardstock.
- ☐ **Connectors:** Hot glue guns (with adult supervision), duct tape, rubber bands, and Velcro (essential for attaching the micro:bit securely).
- ☐ **Decorations:** Pipe cleaners, googly eyes, felt, markers, and scrap fabric.

Software Tools:

- **ML-Machine Toolkit** (As referenced in the document for training the motion model).
- **Microsoft MakeCode** (For coding the emotional response logic).

2. Preparation Guide

- **Secure Attachment:** Before starting, ensure students know the micro:bit must be *firmly* attached to the puppet's "skeleton." If the board rattles or shifts independently of the puppet, the AI training data will be noisy and inaccurate.
 - **Platform Setup:** Pre-load the ML-Machine interface on the student computers to ensure Bluetooth or WebUSB connectivity is functioning.
 - **Movement Space:** Clear a small "stage" area in the classroom where students can test the puppet's movements without hitting desks or other students.
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3. Teaching Plan



Phase	Activity	Learning Objective
Phase 1: Construction	Students build a puppet body using cardboard and recycled materials.	Understand physical engineering and "low-floor" design.
Phase 2: Writing	Students write a 1-2 minute monologue where the puppet expresses at least 3 emotions.	Develop narrative skills and character persona.
Phase 3: AI Training	Students use the accelerometer to record "motion signatures" for emotions (e.g., fast shaking = Anger).	Understand data collection, labeling, and machine learning.
Phase 4: Performance	Students perform their monologue; the micro:bit displays icons based on the puppet's movement.	Reflect on human vs. machine emotional expression.

4. Case Study: "The Grumpy Guardian"

The Concept: A group of middle school students created a puppet named "Gus," a grumpy robot made from an old tissue box who guards a "secret treasure" (a pile of paperclips).

The Movement Signatures (The AI Model):

1. **Curiosity (The Tilt):** When Gus leans forward slowly (Y-axis change), the micro:bit displays a "?" icon.
2. **Anger (The Shiver):** When the "intruder" gets too close, the student shakes the puppet violently (High-frequency X/Y/Z movement). The micro:bit displays a **"Frown/Angry"** face.
3. **Joy (The Jump):** When the intruder leaves, the student moves the puppet in a rhythmic "up and down" motion. The micro:bit displays a **"Heart"** icon.

The Narrative Arc:

The students wrote a script where Gus starts curious about the audience, gets angry when they "touch his treasure," and finally celebrates his victory when the audience backs away.

Student Reflection: During the case study, students realized that the AI sometimes confused "Curiosity" with "Anger" if the tilting was too fast. They learned that **"Differentiable Movement"** (making movements distinct) is the key to a successful machine learning model.

This plan transforms the technical task of coding into a creative, embodied learning experience that bridges the gap between AI and the Arts.

Prior Example:

The link of performance examples and scripts:

<https://upenn.app.box.com/s/mog8gewtz8g9y2ml0bw7a47z4ym233od>

