Reagan Caliendo - rcali3 - rcali3@uic.edu
Munazza Shifa - mshifa2 - mshifa2@uic.edu
Marjea Ahad - mahad4 - mahad4@uic.edu
Chichi Ogugu - cogug3 - cogug3@uic.edu

Holly Jolly Christmas Display

The Holly Jolly Christmas Display is an interactive holiday showcase featuring synchronized lights, music, and special effects. Using four interconnected Arduinos, it combines LED light patterns, music playback, a countdown timer, and confetti effects for a festive atmosphere. Key features include a light sensor for automatic illumination, remote song control, and an emergency shutdown. Bluetooth coordination across the Arduinos ensures unified control, creating a seamless experience. This unique setup transforms a model house into an immersive Christmas display, blending synchronized lighting and sound with interactive elements to bring holiday cheer to life.

1. Overall Description of Project Idea

The Holly Jolly Christmas Display is a festive, interactive light and sound showcase designed to bring the holiday spirit to life on a miniature scale. Our project centers around a model house, where synchronized Christmas lights flash to the beat of pre-recorded holiday music, creating an immersive light show. This display is enhanced by a fan blowing “snow” or confetti for a realistic snowfall effect, an LCD screen displaying holiday messages such as “Happy Holidays”, and a countdown to Christmas on a 7-segment display.

This display will consist of four Arduinos, each Arduino will be dedicated to specific functions within the setup to ensure smooth operation. The main Arduino will act as the central control hub, receiving inputs from the remote, power button, and light sensor, while managing communication between other Arduinos through Bluetooth. A second Arduino will control the playback music and beat detection, allowing LED lights to synchronize with each song. A third Arduino will manage the special effects, including the fan and LCD messages.

Together, these different components will create a cohesive holiday experience, transforming an ordinary cardboard house model into a captivating Christmas light show. It is designed with the intention of providing family-friendly enjoyment. The Holly Jolly Christmas Display will be an engaging, family-friendly, and hands-on approach to holiday decor. It will showcase our team’s use of multiple Arduinos, Bluetooth communication, and various interactive components into one seamless, original design.

2. Initial Project Design stating how Multiple Arduinos will be used

The Holly Jolly Christmas Display will operate using four Arduinos, with each one responsible for overseeing various components of the display.

Arduino 1: Lights Synchronization:The first Arduino will control the Christmas lights around the display. This Arduino will manage multiple LED strips, adjusting brightness and flash patterns according to the beat of the music. It will receive beat data via Bluetooth from the music controller (Arduino 2) and control commands from the 4th Arduino, allowing the lights to synchronize perfectly with the audio, creating an engaging light show.

Arduino 2: Music Playback and Beat Detection: It will play pre-recorded Christmas songs through a connected speaker and will analyze the beat of each song to send tempo information to Arduino 1. This Arduino will also manage volume and track changes, taking signals from the remote controller (Arduino 4) to allow users to adjust music settings.

Arduino 3: Special Effects: The third Arduino will control the special effects, including the fan for blowing confetti or artificial snow, LCD for the Christmas countdown and messages like “Happy Holidays” display. This Arduino will receive signals to activate the fan or change messages.

Arduino 4: Control: The fourth Arduino will handle all user or automatic control elements, like the remote control,central power button and the light sensor.Through the remote, users will be able to change songs, adjust volume, and power the display on and off. The light sensor will adjust the brightness of the lights according to the ambient light level and the power button to manually switch the display on or off.

3. Expected Plan for Use and Communication between the multiple Arduinos

The communication between the four Arduinos in *The Holly Jolly Christmas Display* will be by Bluetooth modules. Arduino 1 (LED)would take commands from the Arduino 2 (music) allowing for light and music sync. Arduino 1 would also receive signals from Arduino 4(control) for brightness adjustment and switching up control. Arduino 2 (Music Playback) will also receive control signals from Arduino 4, ensuring that users can control the audio settings smoothly. Arduino 4 will send activation signals to Arduino 3 when special effects need to be triggered or when users interact with specific controls. For instance, if a user wants to activate the fan for added visual effects, Arduino 4 will send this command to Arduino 3. Hence, the Arduino 4 serves as the control hub, handling all inputs either manually via the remote control and central power button or automatically via the light sensor.

4. Initial Project Design stating Expected Inputs/Outputs

*see diagram for project design

To summarize the project design diagram, there will be four Arduinos. The three inputs (below) will be put into one Arduino board. That board will then send messages to the three remaining Arduinos to determine when certain outputs should be on/off/display certain messages.

INPUTS:

- Remote Control
- Power Button
- Light Sensor

OUTPUT:

- LED Light Strips
- Speaker
- LCD Screen
- Fan
- 7 Segment Display

5. Description of the original work being attempted by your project.

The Holly Jolly Christmas Display is unique, original work because as a holiday-themed project it will combine multiple components into a single synchronized display. Unlike a traditional holiday display setup, our project will combine lights, music, and special effects all in one, these different elements will communicate and work together. We plan on using four Arduinos and each will have a specific function. There will be a Bluetooth coordinated system that will allow different parts to respond to things such as user controls and environmentals factors. This will make for an original and interactive holiday experience.

A key feature of our project is an automatic and responsive setup. For example, a light sensor will turn on all the lights when it gets dark. Thi is something that is not found on a small scale display. We have also added a countdown timer on a 7-segment display and a fan that will blow confetti that will mimic artificial snow for a festive, holiday effect. There will also be a remote control that will allow users to change songs, adjust the volume, and control the lights; this will add to the convenience and interactive nature of the display that we aim for it to be.

In conclusion, *the Holly Jolly Christmas Display* will be unique and different from a typical holiday setup because of its engaging holiday experience that involves various elements combined into a unified, responsive system.

Timeline

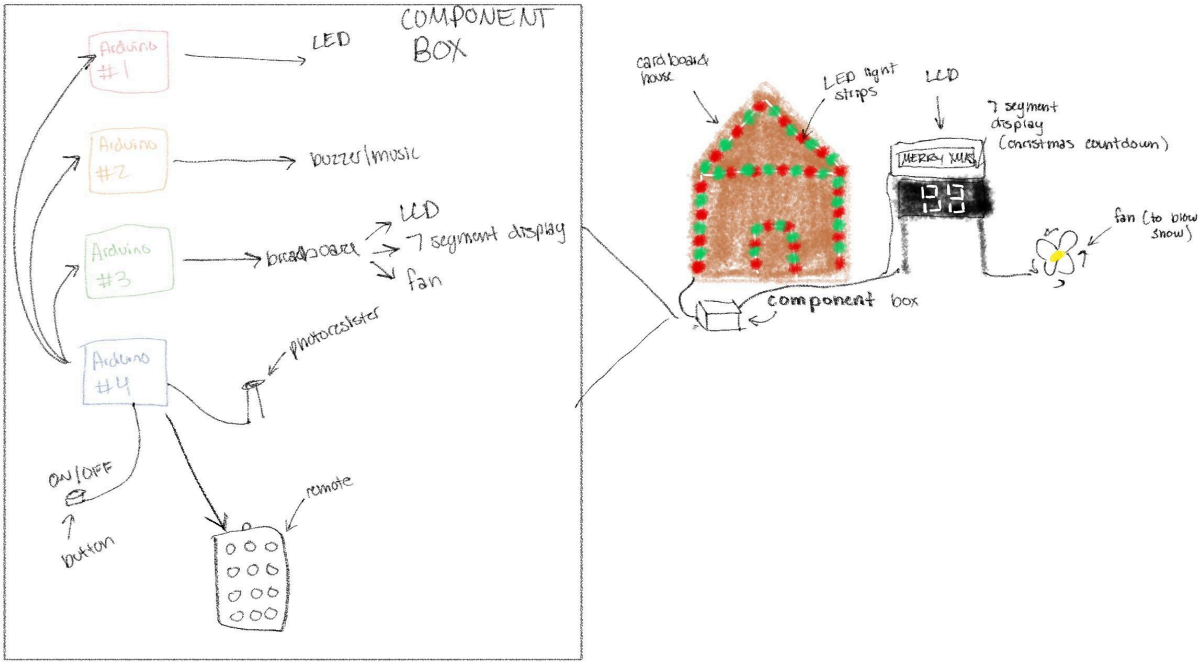
Week 10 Oct 27 - Nov 2	Project Planning and Component Gathering	● Gather materials needed to complete the project ● Research code implementations for each
Week 11 Nov 3 - Nov 9	Basic Component Programming	● Start programming for each component
Week 12 Nov 10 - Nov 16	System Coordination	● Continue programming components ● Test bluetooth connections between components
Week 13 Nov 17 - Nov 23	Building *Design Presentation on Friday, Nov 22	● Begin building the physical components of our project including our model house
Week 14 Nov 24 - Nov 30	Debugging/Final Adjustments	● Iron out any bugs and perfect the design ● Complete project report
Week 15 Dec 1 - Dec 6	*Project Demonstration on Friday, Dec 6	● Present project!

List of Materials Expected to be Needed

- Arduino Uno x4
- Bluetooth Modules x4
- Breadboard
- Wires
- LED WS2812B Strip Lights
- LCD Screen
- 7 Segment Display
- Power Supply for LEDs
- Resistors for LEDs and LCDs
- Buzzer (or speaker) Module
- Photoresistor
- Remote
- Pushbuttons
- Fan
- Motor
- Confetti
- Model construction materials (cardboard, glue, markers, etc.)

References (ongoing list throughout project)

https://youtu.be/MafNmsmBW8s?feature=shared



Code Sketches

Main remote control-hub:

```
Set up communication pins for sending signals to Arduino 1, Arduino
2, and Arduino 3
Set up power button, light sensor, and remote control for inputs

Loop ( ):
    If (power button is pressed){
        Send power on signal to all Arduinos
    }

    Read light sensor level
    Calculate brightness based on ambient light
    Send brightness level to Arduino 1

    If (remote control signal is received){
        If (signal is "Activate Fan"){
            Send fan activation signal to Arduino 3
        }
        If (signal is "Change LCD Message"){
            Send message change signal to Arduino 3
        }
        If (signal is "Next Track"){
            Send next track command to Arduino 2
        }
        If (signal is "Adjust Volume"){
            Send volume adjustment command to Arduino 2
        }
        // Add more remote control commands as needed for
customization
    }
```

Lights Synchronization:

```
Set up communication pins for receiving signals from Arduino 2 and
Arduino 4
Set up LED pin for output

Loop( ):
    If (data is available via Bluetooth){
       Read command from Bluetooth:
}
        If (command is "B" (beat detected from Arduino 2)) {
            Flash LED according to beat pattern
        }Else if (command is "D" (brightness adjustment from Arduino
4)){
             Set LED brightness based on received value
        }
```

Music Playback and Beat Detection:

```
Set up communication pins for sending beat signal to Arduino 1
and receiving  control signals from Arduino 4

Loop ( ):
    Detect beat from music playback
     If (beat is detected){
        Send beat signal to Arduino 1
     }
     If  (command is received from Arduino 4){
        If (command is "Next Track"){
             Change to next track
     }
        If (command is "Adjust Volume"){
            Adjust volume to specified level
     }
     //More commands and personalize and more customizations
      }
```