Arduino Musical Mood Lamp

PROJECT REPORT

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Prepared for: CS 207
December 5, 2019

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1. INTRODUCTION

This project undertaken for this term is the construction of a mood lamp, which is modified to a musical mood lamp. The original project is described and developed by *Andre Infante* on www.makeuseof.com.

The basic idea of this musical night light is having a “mood lamp” that turns on with the absent of light (night time, for example). The photo resistor is used in this project to sense the change in light, and to send signal to the Arduino to turn the night light on. When it is turned on, it gradually changes colours and plays calm music via small speaker attached to the Arduino.

There are a few similar projects that could be found on multiple websites. However, the author did not find one with the music modification, and decided to build one for this project. In both, the original and the modified builds, the lamp is supposed to be stationary, connected to the laptop or a battery. This being said, the lamp can be moved around, if so desired.

2. NOVEL CONTRIBUTION

Author's goal is to replicate the functionality of the original project with a small addition of a photo resistor that will be a core component for turning mood lamp into a night light, and a small speaker. New build will be able to play an audio file from an SD card. Despite how easy the project sounds, the author has never worked with SD modules and/or SD cards during this course, hence this will add some challenge to the project.

3. MOTIVATION

This project was chosen due to author's love for pretty lights and music. As a student, the author found it to have potential to improve mental health by meditating before going to sleep. This project is very simple, yet challenging enough for the author since they have no background hardware building knowledge. Since it is a night light, it is supposed to work in the dark. The darkness 'hides' all the wires and other components of the projects, helping the

user to focus on the light. However, this mood lamp could also play other type of music, and be used in a different atmosphere (e.g., house party).

4. DESIGNING PROCESS

The design process for this project was quite simple. The main components of the meditation night light are RGB LED, photo-resistor, a few resistors, a speaker, an SD card, SD module, and multiple jump wires to connect all the components between each other and Arduino Uno. The author uses 4GB micro SD card that stores a single audio file in format *.wav*. Some household items were needed for this project such as small mason jar and office paper. The author used white office paper placed inside glass jar for the light to be evenly distributed within the jar. However, with such a big expansion in size, the author needed a larger cover, so they used a glass vase. Note that the paper should not cover the top of the glass container so the photo resistor still can detect light/darkness. No extra frame is needed for this project, but it is something that could be considered for future implementations.

5. BUILDING PROCESS

The initial (original) build was fairy simple and took little time to implement. The photo-resistor was placed to the side of the breadboard so it does not go inside the jar that covers the LED and a few wires. This way the light produced by LED won't be confused with the 'outside' light for the photo resistor. The mood lamp is powered by the 5V pin on the Arduino, while the speaker must be connected to PC via USB cable.

The musical version of the mood lamp required a few extra components and many more wires. The author was able to fit everything but the speaker on one breadboard. The speaker has its own plastic container that is as big as the breadboard itself. In the final version of this project, the speaker sits on top of the lamp.

One RGB LED has four legs that represent three colours (red, green, blue) and one ground. The LED is connected to the resistors and to pins ~3, ~5, and ~6 on the Arduino. One analog pin on the Arduino is connected between the photo resistor and one 560 ohm resistor. This allows the photo resistor to sense how much light is reaching it, and sending this info to the Arduino. A low reading

such as 200 is an indicator of a large amount of light, and a high reading of 1000 is an indicator of almost absence of light. During the test, author decided that the absence of light in their rooms starts at value 900, so when the photo resistor sense a value higher than 900, the night light / mood lamp turns on.

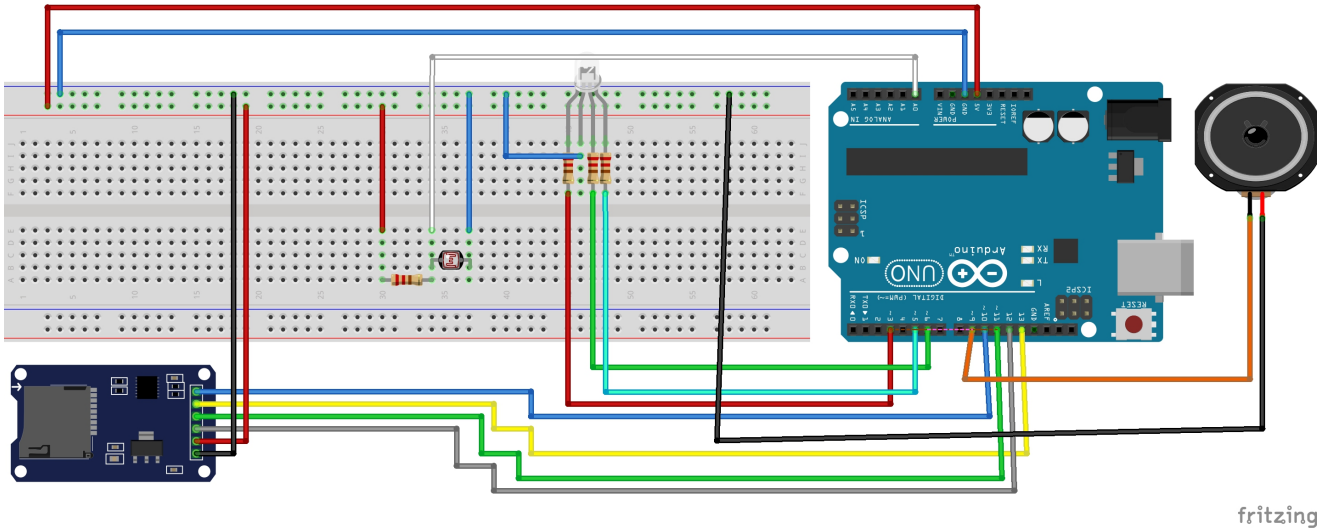
The Ada Fruit SD module contains a 4GB micro SD card, and is connected to Arduino based on the following table:

PIN ON SD MODULE	PIN ON ARDUINO
CS	10
CLK	13
DI	11
DO	12
GND	GND
5V	5V

Two devices use SPI protocol to communicate with each other. Arduino Uno plays a role of a master while Ada Fruit SD module is being a slave.

The author was provided with a big speaker with a built-in amplifier. This really saved a lot of space on a breadboard, since the speaker only used pin 9 on Arduino, and ground pin on breadboard. The built-in amplifier improved volume and quality of the sounds.

Here is final build's breadboard diagram for better understanding of the connection between all the components:



6. USER MANUAL FOR MUSICAL MOOD LAMP

The musical mood lamp is very easy to use. It, however, requires some effort to set up. First, Arduino needs a power source, which could be a battery or a connection to PC via USB cable. The speaker also needs a separate connection to PC via USB cable (you can use a regular charger cable). Since the glass top is not fixed on top of Arduino, the user would need to cover Arduino

and the breadboard with it after set up is complete. There is no need to reconnect any wires on Arduino or the board, unless some changes are desired.

Last step is to upload file named "*Musical_Mood_Lamp.ino*" with a code to the Arduino. The lamp will turn on as soon as it gets dark enough in the room. If the user's environment is not bright/dark enough, the user can simply modify the value of *ambientLight* inside the functions *manageLED* and *manageMusic* until desired reading of brightness/darkness is reached.

```
 function that turns LED on and off based on whether it
id manageLED(){

ambientLight=analogRead(ldrPin);

if(ambientLight>900){
  // calculate brightness for each colour in LED
  for (float x=0;x<PI;x=x+0.00001){
    RGB[0]=255*abs(sin(x*(180/PI)));
    RGB[1]=255*abs(sin((x+PI/3)*(180/PI)));
    RGB[2]=255*abs(sin((x+(2*PI)/3)*(180/PI)));

    // turn LED on
    analogWrite(redLed,RGB[0]);
    analogWrite(greenLed,RGB[1]);
    analogWrite(blueLed,RGB[2]);
  }
```

```
// function that turns music on and off
void manageMusic(){

  ambientLight=analogRead(ldrPin);

  if(ambientLight>900){
    tmrpcm.setVolume(4);
    tmrpcm.quality(1);
    tmrpcm.play("test.wav");
  }
  else{
    tmrpcm.pause();
  }
  delay(1);
  return;
}
```

The volume can be controlled on a line *tmrpcm.setVolume(VOLUME_VALUE)*. Please note, that volume at value 5 is close to a maximum value. After code is uploaded, simply position the lamp anywhere on the desk and enjoy the colourful show in the evening.

7. SETBACKS AND FAILURES

The biggest difficulty of the project was the novelty implementation. After the implementation of music feature was complete, the lamp was not able to play music and change colours at the same time. It seemed that it could do one thing at a time, and it would first read data from the SD card, play the music, while LED is waiting for its turn to change colours.

This issue was fixed by creating separate functions, one is for LED, and another one is for SD module. The two functions are placed inside the loop with no additional *delay*( ) function which seemed to cause the problem before. This way, Arduino was able to run two created functions in parallel.

Another setback was sound quality - music was so quiet, the author could not tell if it was playing at all. The author tired a few different speakers, however the result was the same. Research showed that amplifier is needed for the volume to go up. Unfortunately, the author did not have necessary components to build one. This issue was resolved by obtaining a speaker with a built-in amplifier.

8. MILESTONES

The project is considered a success since a major milestone was reached, and the mood lamp does the required action, which is turning light and music on when it gets dark in the room. Earlier milestones were reached very quick due to access to a working build and Arduino sketch. However, the final milestone took some time to reach due to technical difficulties and lack of time at this time of the semester.

Due to time constraints and work constraints, the author did not implement an extra feature which would be an addition of a push button that would turn music on/off but keep the lights on. This feature would be helpful for people who just want the night light on when they go to sleep, for example. If they decide to throw a party or to mediate, one push on a button will turn the music on again.

Overall, the author is satisfied with the final product, and will consider reaching the extra milestone after the final exams are over.

9. TEAM ROLES

The author is the only team member in a team of one. This could be considered a benefit since they author could manage their own time to work on the project without having to wait for anyone else to do their part. The project was simple enough for one person to work on it while having some challenge to make it interesting. This being said, the author needed help from the instructor and classmates when they faced technical difficulties at the last stage of the project.

10. CONCLUSION

The musical mood lamp was fun and entertaining to work on. The author learned a lot of new content while working on this project. It was quite an interesting process to be able to program something you built yourself. Every time something went wrong, the author had to check both hardware and software to find an issue.

The author would have liked to improve the lamp a little bit by fixing the glass container on top of Arduino in a way that you could move everything at

once rather than taking the lamp apart before relocating it. Another idea was to frost the glass container with glue and sugar (or any other powder) instead of using office paper.

Ultimately, using Arduino Uno was very easy for this project. Project's components are photo resistor to sense light, RGB LED to light up and change colours, SD module with micro SD card that stores music file in *.wav* format, and a speaker with built-in amplifier to play music. This project covers most topics discussed in class lectures and labs, and also adds some practice with SD cards that was not covered in the labs.

The CS207 course definitely brings something new to a computer science experience, such as paying attention to what your code does to a piece of hardware, etc.

11. REFERENCES

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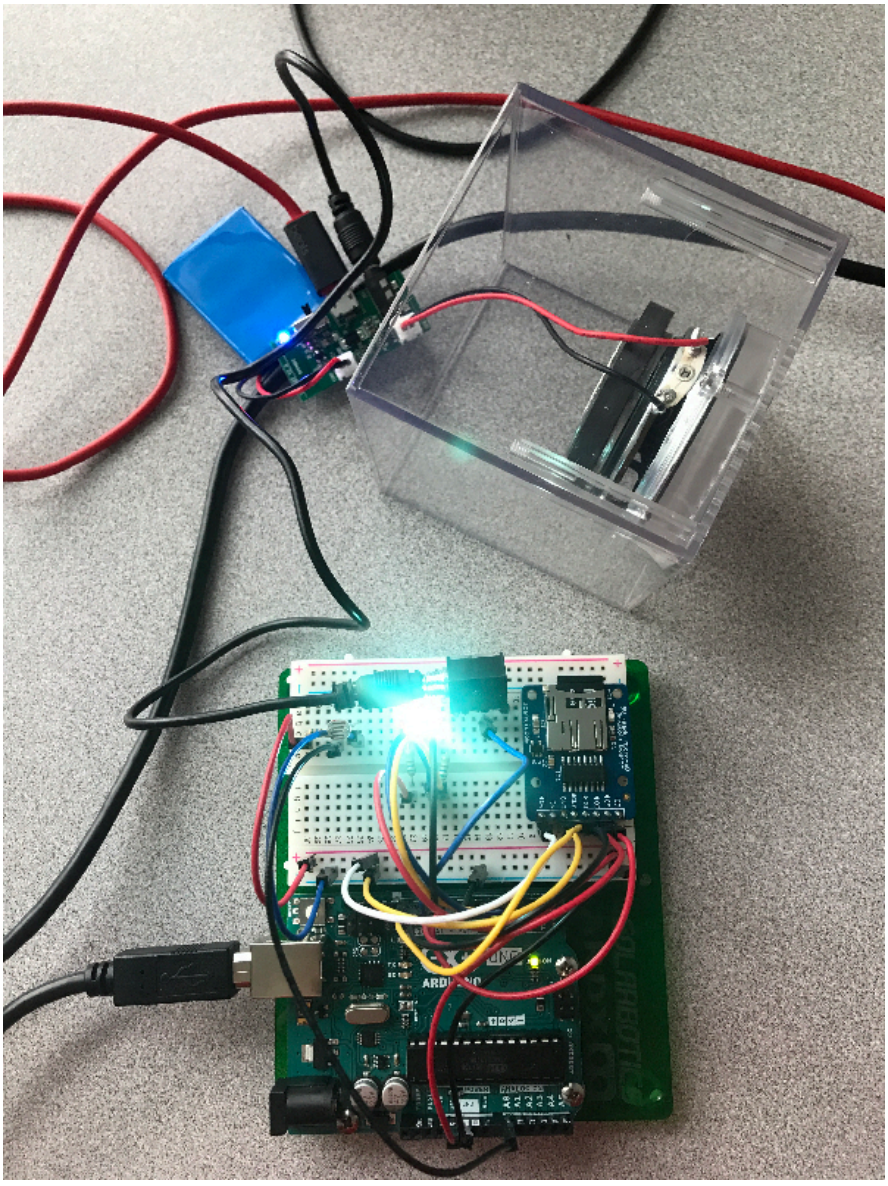
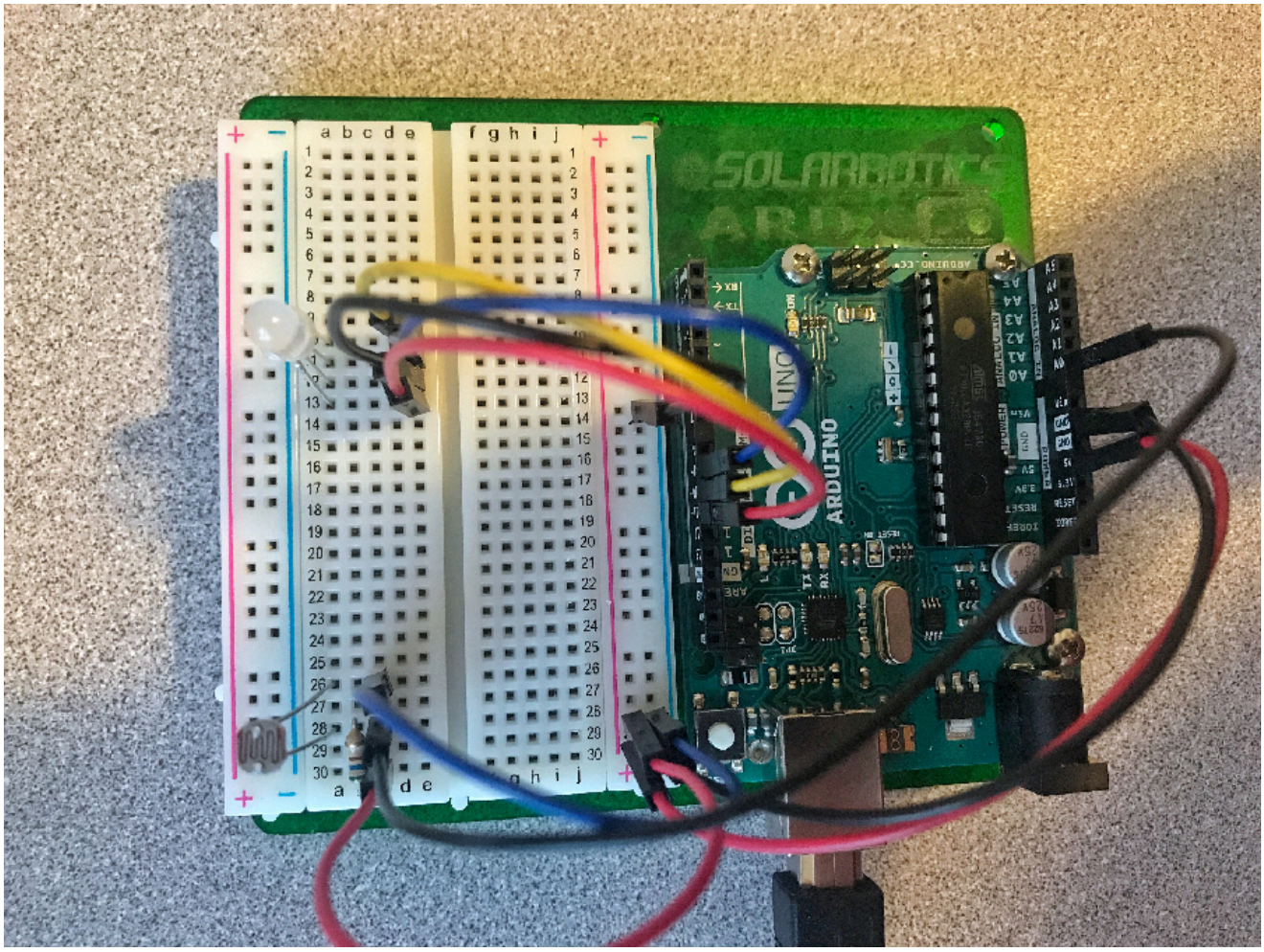
APPENDIX

Appendix A: Mood Lamp Hardware Design - V1



Appendix B: Musical Mood Lamp Hardware Design - V2



Appendix C: Project Images

All the images used for this project can be found in */Images* folder in repository located at https://github.com/shilovay/geeky-CS207/tree/master/Images

Appendix D: Circuit Designs and Diagrams

All the circuit designs and diagrams used for this project can be found in */Diagrams* folder in repository located at:

https://github.com/shilovay/geeky-CS207/tree/master/Diagrams

Appendix D: Code Listings

All the code files used for this project can be found in */Code* folder in repository located at:

https://github.com/shilovay/geeky-CS207/tree/master/Code