Light Fixture Prototype

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INTRODUCTION

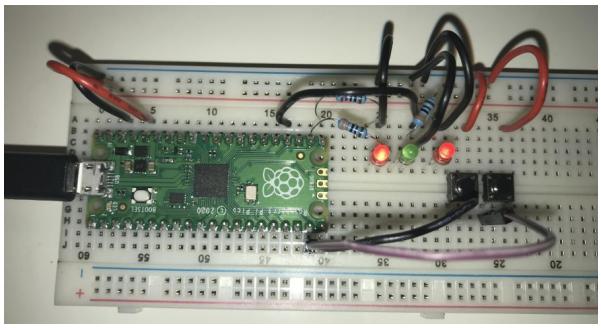
This prototype was designed to simulate a light fixture in a greenhouse for farmers' crops. As various geographical locations do not provide the optimal amount of light for crops to prosper, supplemental lighting is required. This lighting is often in a red to blue ratio, creating a pink colour unpleasant for greenhouse workers [1]. The objective of this light fixture is to add white light for workers to use when they are present.

STAKEHOLDERS

The 2 main stakeholders in this design are the farmers who own the crops and their workers. In this situation, the farmers want their plants to thrive, maximize productivity, and subsequently, optimize their workers' happiness. As their profits depend on their plants, maintaining a light fixture providing the necessary lighting is crucial for farmers. As farmers employ workers, satisfying the workers' needs also increases productivity as the workers want a better working environment with less pink light [1]. Investing in this solution would also make workers feel that their employer is empathetic to their needs, providing more incentive to work. Moreover, farmers would like an efficient and simple design that allows for less of a learning curve as it boosts productivity.

APPARATUS

A Raspberry Pi Pico board, 3 LEDs, 3 220Ω resistors, 2 pushbuttons, and 9 jumper wires were used for the prototype. Due to a lack of resources, the red LEDs in the prototype are considered as the red and blue lights (pink), and the green LED shall be considered as the white light added for the workers. Figures 1 and 2 display the breadboard layout.



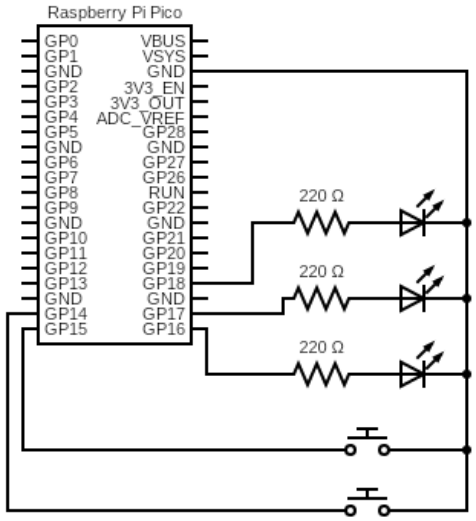


Figure 1. Physical prototype, Figure 2. Circuit schematic

DESIGN

The design utilizes 2 push buttons acting as a mode switch and a white light switch. The first button alternates between 3 modes each time it is pressed: off, plant-only, and plant-and-worker modes.

When the mode is off, no LEDs light up. When the mode is plant-only, the red (pink) LEDs light up. Similarly, both red lights are active in the plant-and-worker mode. However, upon switching to this mode, pushing the second button acts as an on/off light switch for the green LED (white light).

Summary

- Button 1: for the farmer to switch modes - off, plants, plants and workers
- Button 2: for the workers to switch the white light on and off

DESIGN DECISIONS

Mode control

1 button to control the 3 different modes was chosen for simplicity and efficiency. First, it allows the farmer to easily control the lights without workers' interference. The use of 2 buttons allows workers and farmers to only interact with 1 light switch and 1 button respectively, making the system optimized for simplicity. Moreover, 1 button toggling through all modes maximizes efficiency compared to having 1 button for each of the modes as the users would need to learn the functionality of each button.

White light switch

Utilizing the second button as a light switch controlled by workers allows the workers to exploit it upon their needs and saves energy. This was designed for accessibility as the workers could turn the light on and off as they wish during their shifts. As the plant-and-worker mode was designed for farmers to switch on during the day, having the light on for the full duration when workers may be away is cost and energy inefficient. Thus, the second button allowing workers to have the ability to turn the light off saves energy and cost for the farmer. Therefore, this design decision satisfies farmers' want to cut down on costs, as well as workers' needs to have accessible white light.

REFERENCES

[1] E. Runkle, "Investment considerations for greenhouse lighting", *Michigan State University*, 2017. Accessed: www.canr.msu.edu/resources/investment-considerations-for-greenhouse-lighting