Light emitting diodes or LEDs are a relatively new technology to the lighting industry. As they are being applied to serve different purposes, the benefits that they bring continue to increase. One such area that is and will continue to benefit from LEDs is the Agricultural Industry.

LEDs are an electric component that emits light when connected to direct current (History of LEDs - Light Emitting Diodes, 2018). Its functionality is based on the electroluminescent principle and can emit light in visible spectrum. They are also capable of emitting infrared and ultraviolet light (History of LEDs - Light Emitting Diodes, 2018). LEDs have a low energy consumption and are small in size. Their lifetime typically is longer than incandescent bulbs and have a faster switching capability. Therefore, their applicability has a wide range.

A British experimenter, Henry Joseph Round, was the first to make note of what would later become an LED. In 1905, he noticed that when a potential of 10 volts was applied to a silicon carbide crystal, it would emit yellowish light (History of LEDs - Light Emitting Diodes, 2018). However, in 1927, Oleg Vladimirovich Losev from Russia was the first to investigate and propose a theory in his paper “Luminous carborundum detector and detection effect and oscillations with crystals“ (History of LEDs - Light Emitting Diodes, 2018). Then it was not until 1955 that progress was made. Rubin Braunstein, who worked for the Radio Corporation of America, reported that some simple diodes emit infrared light when connected to a current (History of LEDs - Light Emitting Diodes, 2018). Once Gary Pittman and Bob Baird from Texas Instruments found that diodes can emit infrared light every time they are connected to current, research and discovery on the topic boomed (History of LEDs - Light Emitting Diodes, 2018). But it was not until 1994 that LEDs were inexpensive enough to be included in commercial use (). The first LEDs cost about $200 per piece (History of LEDs - Light Emitting Diodes, 2018). However, in the 1970’s Fairchild Semiconductors were able to succeed in reducing the cost of individual LEDs to 5 cents (History of LEDs - Light Emitting Diodes, 2018). They did this through using planar process in production of semiconductor chips for the light emitting diodes (History of LEDs - Light Emitting Diodes, 2018). Now LEDs are being put to many good uses.

LEDs have many advantages, but they also have flaws. Advantages include that they emit more light per watt than incandescent lamps, they are small in size, and they take nanoseconds to turn on/off (Myers, 2018). LEDs also have a much longer lifespan and are more resilient against damage. Their flaws include a high price per lumen, high dependence of the outside temperature and easy overheating if the outside temperature is too high and there is no Heatsink (Myers, 2018). Despite these flaws, LEDs uses are still expanding.

LEDs can be used in multiple ways within the Agricultural Industry. The area that I would like to focus on, being that of lighting in any size and functional space. I propose an LED light, that would account for natural light that is already entering the room and adjusting groups of LEDs to respond. Therefore , giving the correct amount of light needed within a space. The LED lamp would save more energy than using other forms of lighting and would be able to be applied in many differing functional spaces. They could also potentially be configured to be used in greenhouses or urban farming spaces.

Seeing as every space or facility that could be able to benefit from these LED light fixtures is potentially a different size the dimensions should be customizable. However, for the basic model there are two sets of dimensions that would be available. The first would be a 24 inch by 106-inch rectangular setup (not including height yet). The second would be a 12 inch by 53-inch rectangular setup (not including height yet). The larger and first setup is catering toward larger areas that need lighting. The larger design provides for a greater amount of surface area to be covered, allowing for less lights needing to be installed. The second elongated setup caters toward the greenhouse and urban farming. Typically, greenhouses and urban farming establishments arrange their plants into rows. Therefore, they do not need as wide of lights to be focused on their plants, but instead they need length.

The materials used to make these LED light fixtures has to be specialized to overcome some of the flaws within using LEDs. The casing that the components will be housed in will be made of plastic. LEDs generate heat and because you do not want them to overheat metal casing would not be a good idea. Therefore, a white polycarbonate would be used to make the casing for the light’s components. Polycarbonate is high-impact and lightweight and therefore, a good use for the lighting casing (A&C Plastics Inc., 2018). There is also a plastic sheet that will be used to cover the LEDs. However, the light needs to be able to travel well through this plastic sheet. Due to the customizability that is desired, there are many options for what materials can be used to place over the lights. One option is Acrylic Plexiglass. Acrylic plexiglass is one of the most common material used in manufacturing. Designers continuously select this material due the fact that its transparent polymers are a good alternative to glass (A&C Plastics Inc., 2018). Polycarbonate sheets can also be used. It is high-impact, lightweight, and is flexible, providing for a shatter resistant substitute for glass (A&C Plastics Inc., 2018). However, the two best options are the light guide panel (LGP) or the light diffusion sheet (LD). The LGP give excellent brightness and evenness of illumination (A&C Plastics Inc., 2018). It is formulated with evenly dispersed diffusion particles resulting in bright and uniform illumination (A&C Plastics Inc., 2018). This sheet also helps to maintain energy efficiency in requiring less energy to illuminate large areas. The LD sheet is a polycarbonate sheet designed with a technology that provides excellent light uniformity without diminishing light transmission (A&C Plastics Inc., 2018). The Proprietary diffuser technology used eliminated visible hot spots form pinpoint LED lights (A&C Plastics Inc., 2018).

There are many different kinds of LEDs that all have differing features. The types include Through-hole LEDs, Surface Mount LEDs (SMD LEDs), Bi-color LEDs, RGB LEDs, and High-Power LEDs. Within the light fixture there will be Through-hole LEDs, because they are the most versatile, energy efficient, and take up the least amount of space. At a first glance, High-Power LEDs seemed like they may be a better choice (they are often used in flashlights and Automobile Headlights); however, they use a lot of power and need some major cooling in order to have a long-lasting lifespan (Ravi, 2017). Thus, making Through-hole LEDs, the better option. Through-hole LEDs come in different sizes and colors as well. There are 3mm, 5mm, and 8mm and colors include white, yellow, blue green, and red. The standard size of LEDs included within the light fixture will be 5mm(large light will have about 64,600 and the small will have about 16,150) , while the color will be customizable. The color will be customizable because of the differing use cases (standard will be white or white yellow combination). The breadboard that will be housed in the light casing will also be custom made to fit within the casing and hold the proper number of LEDs.

Photoresistors are the determining factor to how bright the LEDs will shine at a given time. A photoresistor is a light sensitive device, that is used to indicate the presence or absence of light, or light intensity (Resistorguide, 2018). In a dark area their resistance is very high, but when exposed to light the resistance drops(Resistorguide,2018). The photoresistors for the LED light fixture will be placed and housed inside of the polycarbonate casing, so that they are below the LEDs. They will not be covered by any plastic layers or sheets so that they can accurately read the light within their area. There will be one photoresistor for every 13.25 x 12 (inches) for both models. Each photoresistor will control that specific array of LEDs. A switch will be installed so that the lights can be completely turned off when desired. The light fixtures can be preprogrammed, however, due to the fact that every space and person preference is different computing units will also be installed. They can either be housed above or within the light casing or installed into a wall, near the switch for easy access and testing. This computing system will not be connected to a network or internet source simply for security reasons.

Cooling is very important when it comes to LED lighting. When temperature is not managed with LEDs, most of the input power can be lost, brightness and efficiency will be lost, and the lifespan of the LED will decrease. Therefore, thermoplastic heat sinks will be used in the lighting fixtures in order to manage and handle heat. Thermoplastic heat sinks can be molded into more shapes than aluminum or copper and are much more light weight (LEDSupply, 2018). The heatsink will be designed as a passive pinned or finned Heatsink. A Finned Heatsink is a Heat Spreader that has pillars or pins build on top in order to increase surface area (Techquickie, 2014). There will also be fans build on top of the Finned Heatsinks to increase heat dissipation even more.

LEDs will continue to advance and improve, and in doing so will bring benefits to many industries. LEDs will continue to make their way into more lighting applications and will improve with every application, especially within the area of urban farming and greenhouse technology. With continued research and new inventions and applications LEDs, even with their flaws will still help to better society.

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