Automatic Curtain Blinds Motorized with Respect to Intensity of Lights

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Abstract— A smart office home system is a system that consists of control and management functions within a home environment intended for enhancing the living quality of its inhabitants through functions such as home appliances of four types based on its primary function, namely energy, security, entertainment, and health care. One of the most common applications of the smart home system is for energy management purposes, such as power monitoring and energy conservation. A curtain open/close controller. To achieve this, the NEMA 17 stepper motor is used as an actuator with the assistance of A4988 drivers. The motor is controlled using Arduino UNO which is chosen due to its low power consumption. The Arduino controls the direction of the motor by using a pulse width modulation logic signals emitted from input/output pins, meanwhile, the control is done by using the LDR sensor. Based on the curtain that can be controlled wirelessly through the Bluetooth module. The amount of the consumed power makes it suitable for low-power operation and in alignment with the smart Office and Home systems.

Keywords: Arduino UNO, NEMA 17 Stepper Motor, A4988 Drivers, Bluetooth Module, LDR Sensor, Energy Conservation

I. INTRODUCTION

A curtain serves as cover against the sun, to manage air circulation and decorative purposes. In general, a curtain can be classified as a decorative element or fully-operable item for managing the room. One of the means for indirect control is by controlling the curtains or blinds, which serves to regulate lighting and heat within the house. These functions are supported by including devices for whether direct control and monitoring such as smart plug and monitoring system, or indirect control by manipulating the environment. Smart office or home systems generally utilize technology such as wireless sensor networks to enable functions such as remote controlling and monitoring, thus enhancing convenience for a house's inhabitant.

A scaled-down prototype was constructed, consisting of a frame with a window on one side, and a curtain in front of it. It was used to measure actual energy savings and also compare theoretical coefficients with experimentally procured ones, and extrapolate the results unto a larger scale. Heat transfer rates both with and without the curtain were experimentally tested.

II. WHY TO MAKE CURTAINS SMART

The automatic curtains are designed for office or home use for consuming less energy in the day time. Mostly in IT industries and large scale companies, the working time is from 7 am to 5 pm which uses averagely 15000watts (15 kW) per day. With the use of smart curtains, it can reduce the light and temperature adjustments system to minimum use and which can reduce the energy consumption by up to 60%. By use of natural sources and controlling the intensity of light coming in can easily adjust the temperature and luminance of the room. Our machine uses a maximum of 20 watts per day which is very less compared to a one hour use of air conditioner.

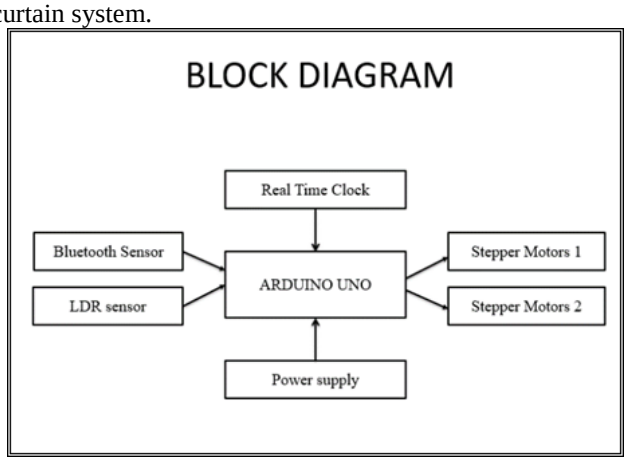
III. WORKING

The basic concept of the machine is to roll down the curtains, focusing on the office use type curtains to which can be open at a particular time when the office opens and can close when the office closes automatically. It has an additional curtain that comes down when the sun intensity is too high, which can increase the room temperature easily. The second curtain contains heat reflecting properties and allowing to give the same amount of luminance. The body of the machine is made of fibreglass which reduce the weight of the object, making it portable to anywhere easy.

The NEMA 17 stepper motor is used as actuator with the assistance of A4988 drivers. The motor is controlled using Arduino UNO which is chosen due to its low power consumption. The Arduino controls the motors direction by using a pulse width modulation logic signals emitted from input/output pins, meanwhile, the control is done by using LDR sensor. Based on the curtain that can be controlled wirelessly through the Bluetooth module.

The use of stepper motor gives us the benefits of adjusting the height of curtains opening manually as well as automatically. The sensors used are so low power consuming.

The working is easily explained by the block diagram and the circuit diagram of the Automatic rolling curtain system.



IV. SYSTEM OVERVIEW

A. *Hardware System*

1) *Arduino UNO*

The core of the project is the Arduino UNO microcontroller board that has a built in AT mega 328P microcontroller. Basically a microcontroller is a computer placed in a small chip. It differs from ordinary computers due to its more

limited capabilities. For example, it is often only capable of running one program at a time, with limited performance. The Arduino UNO is providing support for the microcontroller with 14 easy accessible digital input/output pins, 6 analog pins, reset button, power jack and USB port among other things.

2) Stepper motor NEMA 17

A NEMA 17 stepper motor is a stepper motor with a 1.7 x 1.7 inch (43.18 x 43.18 mm) faceplate. The NEMA 17 is larger and generally heavier than for example a NEMA 14, but this also means it has more room to put a higher torque. However, its size is not an indication of its power.

- 1.5A to 1.8A current per phase
- 1-4 volts
- 3 to 8 inductance per phase
- 1.8 Or 0.9 degrees per step (200/400 steps/rev respectively)
- 44 N·cm (62kg·cm, 4.5kg·cm) or more holding torque

3) Stepper Motor Driver A4988

Microstepping bipolar stepper motor driver features adjustable current limiting, over-current and over-temperature protection, and five different microstep resolutions (down to 1/16-step). It operates from 8 V to 35 V and can deliver up to approximately 1 A per phase without a heat sink or forced air flow (it is rated for 2 A per coil with sufficient additional cooling).

4) Bluetooth Module

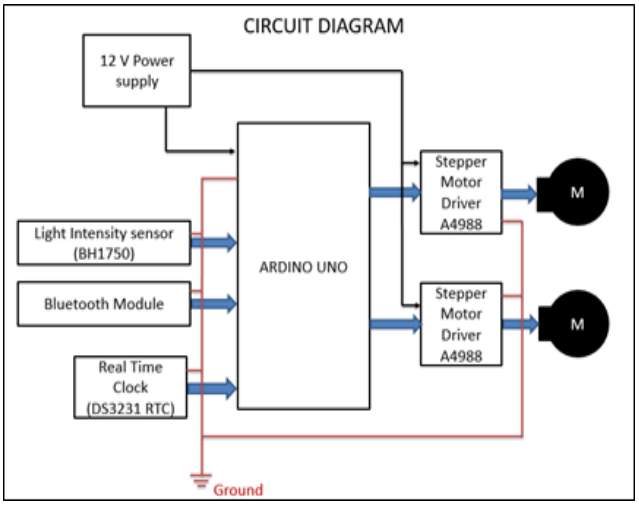
The HC-06 is a class 2 slave Bluetooth module designed for transparent wireless serial communication. Once it is paired to a master Bluetooth device such as PC, smart phones and tablet, its operation becomes transparent to the user. All data received through the serial input is immediately transmitted over the air. When the module receives wireless data, it is sent out through the serial interface exactly at it is received. No user code specific to the Bluetooth module is needed at all in the user microcontroller program.

5) BH1750 Light Intensity Sensor

This is a BH1750 light intensity sensor breakout board with a 16 bit AD converter built-in which can directly output a digital signal, there is no need for complicated calculations. This is a more acurate and easier to use version of the simple LDR which only outputs a voltage that needs to be calculated in order to obtain meaningful data. With the BH1750 Light Sensor intensity can be directly measured by the luxmeter, without needing to make calculations. The data which is output by this sensor is directly output in Lux (Lx). When objects which are lighted in homogeneous get the 1 lx luminous flux in one square meter, their light intensity is 1lx. Sometimes to take good advantage of the illuminant, you can add a reflector to the illuminant.So that there will be more luminous flux in some directions and it can increase the ilumination of the target surface.

6) DS1302 Real Time Clock Module

Real-time clock counts minutes, seconds, date, hours, month day of the week, year and leap-year compensation up to 2100. DS1302 is a tickle-charge timekeeping chip which contains a real-time clock/calendar and 31 bytes of static RAM. DS1302 uses serial communication to interact with microcontrollers. Also, it automatically adjust the date for the month with fewer days. Clock operates in 24hr or 12hr format with an AM/PM indicator.



V. ADVANTAGE

A. Convenience

Motorized blinds can be opened and closed simply by touching a button, a remote control, or an app on a smartphone. Window coverings are a proven way to reduce solar gain and prevent heat loss, and if they are this easy to open and close, it's much more likely you'll remember to do so to benefit you and your environment. Additionally, the ability to set schedules to open and close them at specific times means you may never have to worry about them at all.

B. Energy Savings

Connecting motorized blinds to a smart home hub can help minimize the amount of energy your HVAC system uses by allowing the blinds to react independently to readings from temperature and sunlight sensors also connected to the smart hub. Consequently, the blinds will actually know when to close during the hottest part of the day to reduce HVAC usage or whether to open during a sunny day in the winter to allow the sun to heat a room naturally.

C. Smart Home Integration

Smart thermostats have a trove of data to use to determine whether opening or closing the smart blinds will help reduce energy use, such as what time of day it is, what the weather is like outside, and what the temperature is in the home. Using all these data points, the thermostat can sense a room is getting too hot and close the shades instead of turning on the air conditioning or do the reverse when it knows a room is cooler than it should be.

D. Smart Lighting

When paired with smart lighting, smart blinds can help maximize the amount of daylight in your home to cut down on electricity usage. For example, opening the blinds can trigger smart lighting to turn off, and vice versa.

E. Add R-Value

Even without smarts, motorized blinds can add a significant insulation value to your windows. The traditional roller and honeycomb blinds offer an R value of 4.3. (A typical double

glazed window has an R value of 2.0.) You can also get motorized drapes that will add an insulating layer to your windows.

F. Safety

As any parent will know, the lack of cords with motorized blinds is a major safety bonus—you won't have to worry about keeping them out of reach of your children. However, in a smart home, shades can also provide additional safety benefits. Lutron's shades will connect to Nest's Protect Smoke Alarm to automatically open them when a fire is detected inside, allowing emergency responders to see into the home.

VI. CONCLUSION

It's theoretically possible to conserve energy using a control system to regulate the state of a roller curtain based on feedback from temperature- and lux sensors. This has also been shown to be practically realizable in the form of a small scale prototype. During the course of the experiments, it has been found that convection around the body of a curtain is a potentially large source of energy loss for a window-curtain system. It has also been shown that reflection and thermal radiation plays a significant role when calculating the net energy entering a room due to solar radiation.

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