Rethinking Home Automation: Development of a Simple Device for Controlling a Light Switch

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Abstract

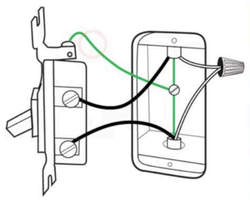
The goal of this project is to develop a low cost and user-friendly device for remote actuation of light switches. We envision a product that is simple to install, easy to control, and able to function with a variety of light switch geometries. This device can minimize the inconvenience as well as the risk of injuries from turning the light on and off in the dark, especially for elderly people. For this target end user, the device must be simple and require no technical knowledge. We design a electro-mechanical system that will be mounted to the outside of a light switch and controlled by a remote or an app on smartphone.

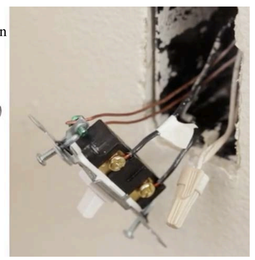
Background

Light switch is an essential part of home appliances. With the development technology, the level of convenience at home becomes a priority. There have been innovations that seek to improve the user's experience with light switch control:

- Smart home: Includes smart light switch control that allows you to control the light everywhere in the house with a remote. However, most of these systems require some level of change in the wiring system that requires technical knowledge or expert installation, and are often relatively expensive.

Belkin WeMo Light Switch Installation

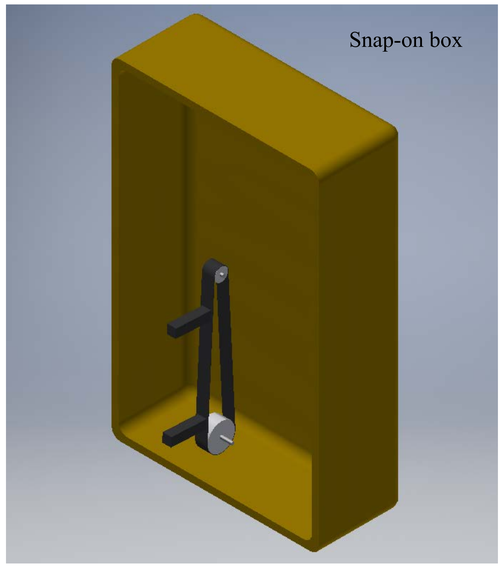




- Motion sensor: Is utilized to turn the light on/off when you walk in and out of the room. However, this only applies to newer and often commercial/ institutional buildings.

We feel the need to have a better solution that will allow for controlling the light switch in a more user-friendly and economical way. We came up with a design of a small device that can be snapped on the existing light switch, with a portable remote control/ smartphone app so the users can control it from a distance.

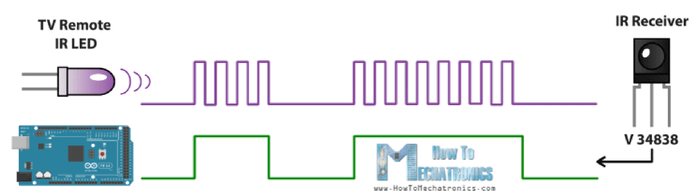
Design and Operation



- **Mechanical Actuator**
  - Controls the light switch after the box has been snapped on to the switch
  - Generates linear motion from rotational motion using gears around an oval-shaped structure
- **Control Circuit Board**
  - Infrared (IR) Receiver: converts the IR light from the remote control to electrical signal and passes it to the microcontroller;
  - RF Circuit: receive signal from the app in the smartphone using an antenna-equipped chip;
- **Battery**
  - Attached inside the box and is rechargeable
  - Users can take the box off and charge it with a simple USB cord

Implementation

- **Remote Control:**
  - Control the light switch with a remote controler
  - Convenient for elderly people, those do not own smartphone
  - Can be used within 30 feet from the light switch, pointed directly
  - Uses the same technology as the one used by a television remote controller
  - Uses infrared rays (IR) instead of radio frequency (RF), so it will need to be pointed directly to the device with no obstruction between the path.



- **Smart phone app**
  - Uses an app that runs iOS or Android in smart phone
  - Uses Bluetooth technology to send RF signals to device
  - Allows for the light switch to be controlled from anywhere in the house

Advantages

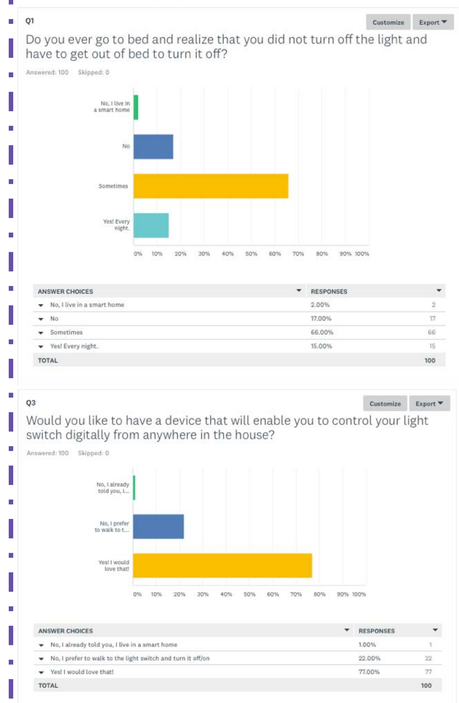
- No need to change the wiring system
- Allow for digital control of the light, while still able to control the light switch manually as usual
- The exterior of the light switch actuator can be used as a decoration
- One of the biggest disadvantage of smart home installation is vulnerability to online insecurity, as most these systems are controlled through online apps. This can be avoided this device as it is remote and app controlled

Popular Smart Home Options

Technology	Function	Price
Belkin WeMo	Using motion sensors and programmable apps to control appliances remotely	$90 + Installation
Frontpoint	Automated Home Security System	$100
Control 4 My Home	Control Lighting, temperature and security systems remotely	$100/year + Installation
Crestron	Full automation of the house	Cost depends on features
Savent	Remote controlled automation of the house	Basic system $500, Full system $1600

Market research

According to our survey of 100 participants, the result shows a demand for this device as shown in the graphs.



Application

- People living in rented housing that cannot change wiring system
- Old hospital buildings that do not have a smart home installed
- Old nursing home buildings
- College dorms

Next steps

- Research into the battery usage of actuator and make it more energy-efficient
- Create a prototype for the mechanical actuator and the remote control
- Design and print the plastic cover using 3D printing
- Program a smart phone application