Final Project Report

Tripwire Alarm

Information Technology
President University

2021

Fauzan Lucky Alana Iskandar (001201900048)

Ibrahim Syah Qardhawi (001201900112)

Introduction

Modern home security appliances offer a wide array of protection against home invasion. These appliances ranges from a simple house lock, 24-hour video surveillance, to sophisticated biometric scanner; each of which have very specific goal to accomplish. However, they all boil down to the same idea; to prevent unauthorized personnel to get access inside the house.

In this paper, we propose a laser based tripwire-alarm. This tripwire-alarm will trigger whenever any physical object passes through the tripwire; In which case it will alarm the security personnel of the potential threat. The tripwire-alarm is strategically positioned and connected to a spotlight that will spot the potential intruder. However, in our model, we are only going to construct a simplified prototype connected to a relay instead of the actual spotlight.

- Demands : There hasn't been any shortage of demand for a preventive security appliances like our tripwire-alarm. The tripwire itself can be connected not only to a spotlight, but any contraption our client so choose. Homeowners may only need to call the police, an enterprise on the other hand may need to perform a lockdown on their building.
- Needs : A reliable and responsive tripwire-alarm that is safe, easy to use, and can inform security personnel whenever any object passes through the tripwire.
- Justification : Tripwire-alarm is relatively cheap, and highly configurable; allowing other robot to work with the tripwire for other security measures besides spotting intruders with spotlight.

Objectives

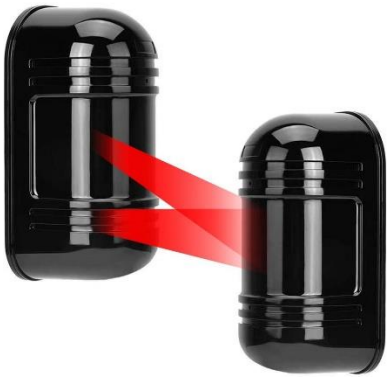
- Aim : To detect potential threat that passes through restricted area and alarm security personnel of said activity.
- Limitation : The tripwire itself does not prevent potential threat from accessing an area, only to detect and inform security personnel of said intrusion.

Requirements

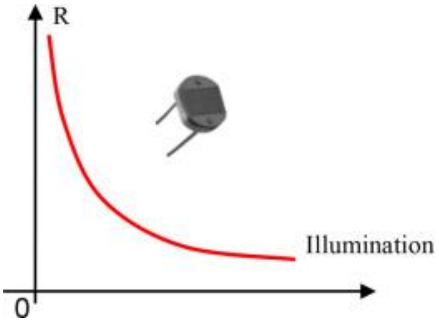
- Safety : Users can use the robot without any personal health and safety risk.
- Accessibility : Users can easily use the robot without extensive experience or any requisite training.
- Modularity : Users can easily connect the tripwire to any other contraption besides turning on a spotlight.
- Affordability : The robot must be composed of relatively affordable technologies.

Literature Studies

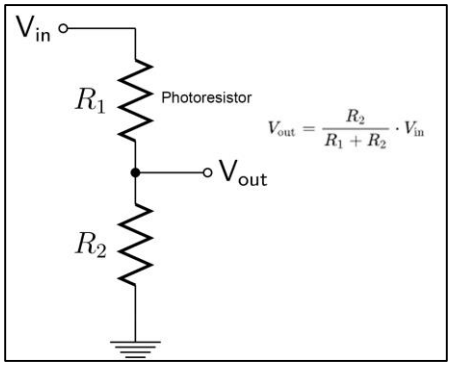
- Existing products in the market: Dahszhi Dual Laser Detector Alarm Beam Sensor.



- How they work: Using laser to point a light at a light detector, then detecting if there are any changes on the light detector. e.g: The amount of light would noticeably decrease when the laser is blocked and can't get to the detector
- Component used: Laser and light dependent resistor.
- Basic theory:
    - Light dependent resistor: Light dependent resistor, or photoresistor, are resistors which its resistance is dependent on the amount of light is received on its face. The brighter it is, the less resistance.



    - Laser: A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. Unlike a normal light source, a laser device is able to be focused to a tight spot. With this, the light can be focused to the photoresistor.
    - Voltage divider: A voltage divider is a simple circuit which produces an output voltage that is a fraction of the input voltage.



In a normal situation, the laser will point at the photoresistor, which causes the resistance to be low. When the laser is blocked, the photoresistor will no longer be illuminated, therefore

raising the resistance. Using the formula above, when the resistance is raised, the output voltage will drop.

Methodology

- To detect object that passes through, we used a laser and photoresistor. A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. Unlike a normal light source, a laser device is able to be focused to a tight spot; in our case, we want the laser to point to a photoresistor. For our model, we use a 5V 650nm Laser diode.

- Light dependent resistor, or photoresistor, are resistors in which its resistance is dependent on the amount of light is received on its face. The brighter it is, the less resistance. For our model, we use a standard photoresistor.

- To allow the tripwire-alarm to perform under different light conditions, we used a simple switch that recalibrate the light threshold of the photoresistor. In addition, this switch also acts as the reset button when the tripwire is triggered. For our model, we use two momentary switch/push button.

- Light condition might be so bright that the effect of the laser to the photoresistor is negligible. To solve this, we covered the photoresistor from unwanted light. For our model, we use a simple cover with plastic.

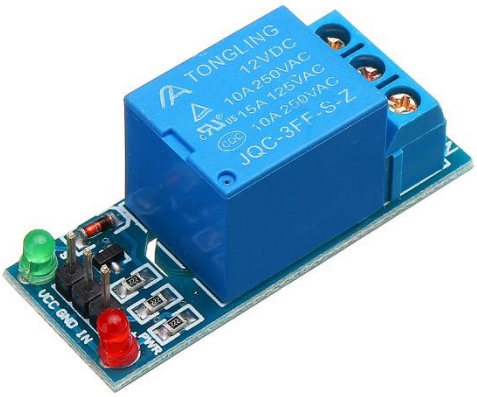
- To indicate the state of the tripwire, we utilized an RGB LED; green is ready, yellow is idle/waiting to be set, red is triggered. For our model, we use RGB LED Common Cathode.

- To notify users when the tripwire is triggered, we utilized a buzzer to act as an alarm. For our model, we use Active piezoelectric speaker/buzzer.

- To control the logic and program the robot, we use Arduino Uno. Arduino boards have analog pins, which are able to map operating voltages (5V or 3.3V) into integer values of 1024. The output voltage from the voltage divider is then connected to this pin. With this pin, the Arduino board can detect when the voltage drops. Uno is sufficient for our model because we only utilized 7 I/O ports in total.

- To control the resistance of the circuitry, we use standard resistors with varying resistance. One 100Ω Resistor, three 220Ω Resistors, one 330Ω Resistor, and three 10kΩ Resistors.

- Last but not least, we use a relay for the model.

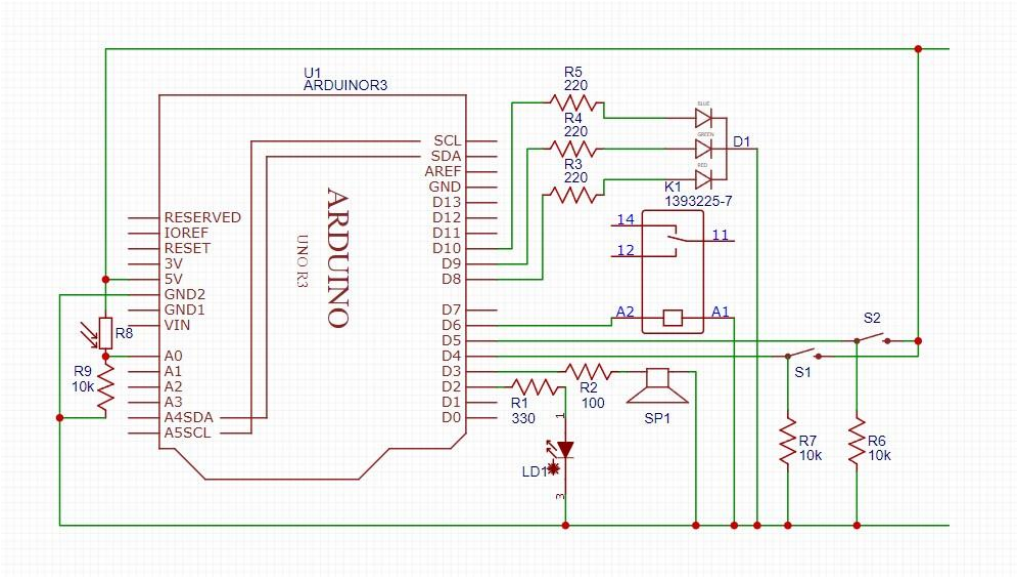


All of the above components have met our initial requirements of being relatively affordable. In total, we utilized these components for our model:

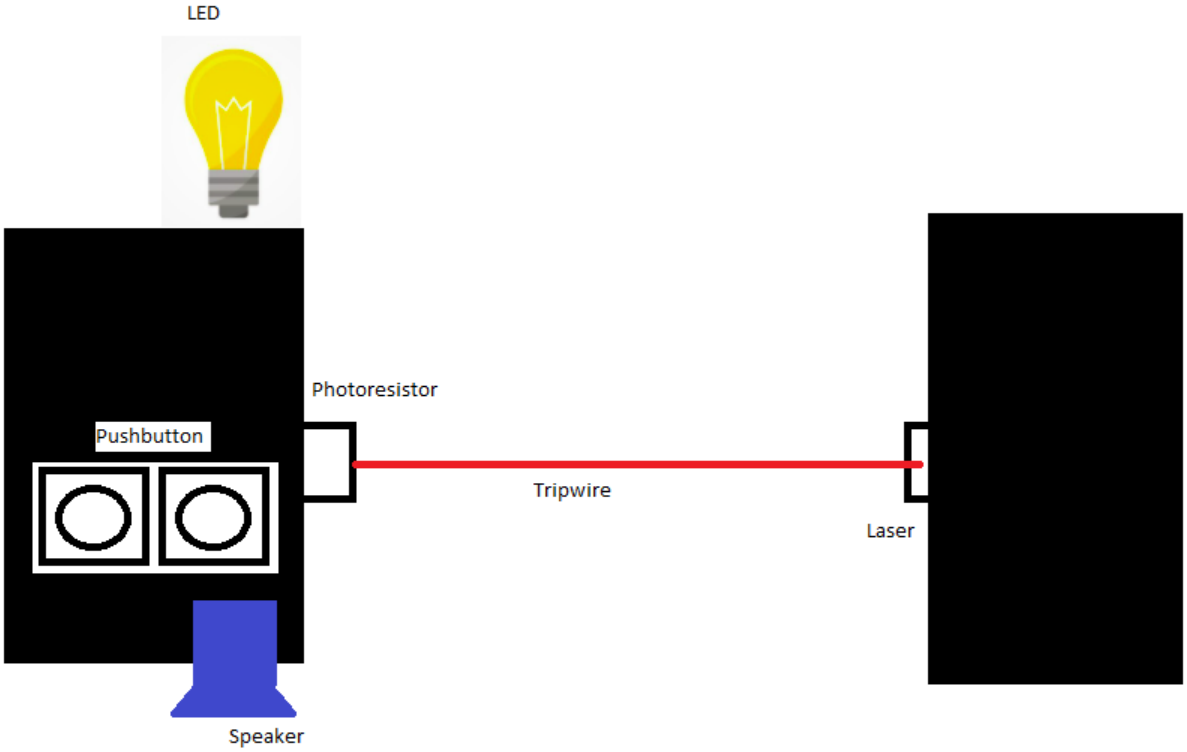
- 1x Arduino Uno
- 1x 5V 650nm Laser diode
- 1x Photoresistor
- 1x RGB LED Common Cathode
- 1x Active piezoelectric speaker/buzzer
- 2x Momentary switch/push button
- 1x 100Ω Resistor
- 3x 220Ω Resistor
- 1x 330Ω Resistor
- 3x 10kΩ Resistor
- 1x Relay

Design

- Hardware design
  The schematic for the circuit is as follows:



The sketch of the final product is the following:

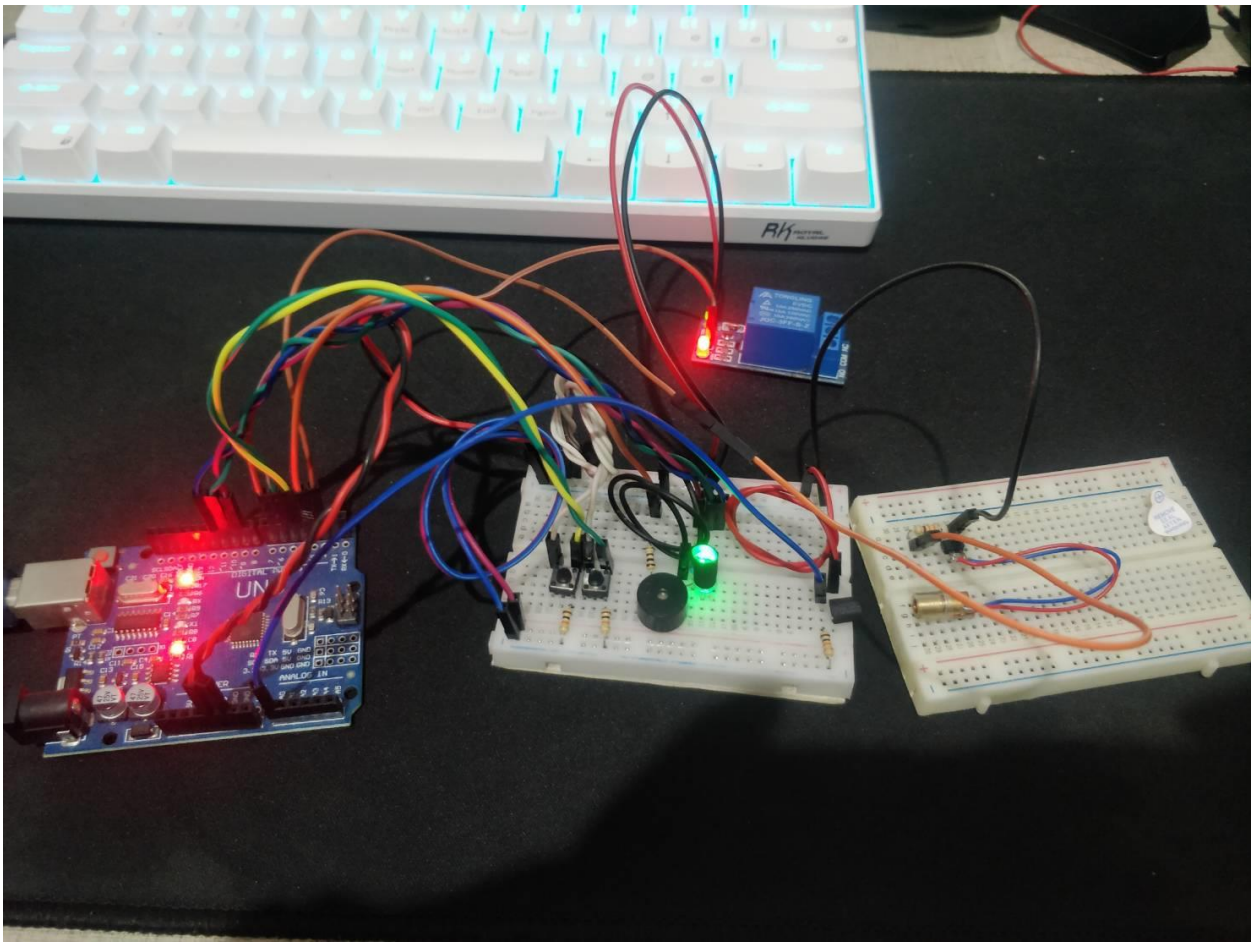


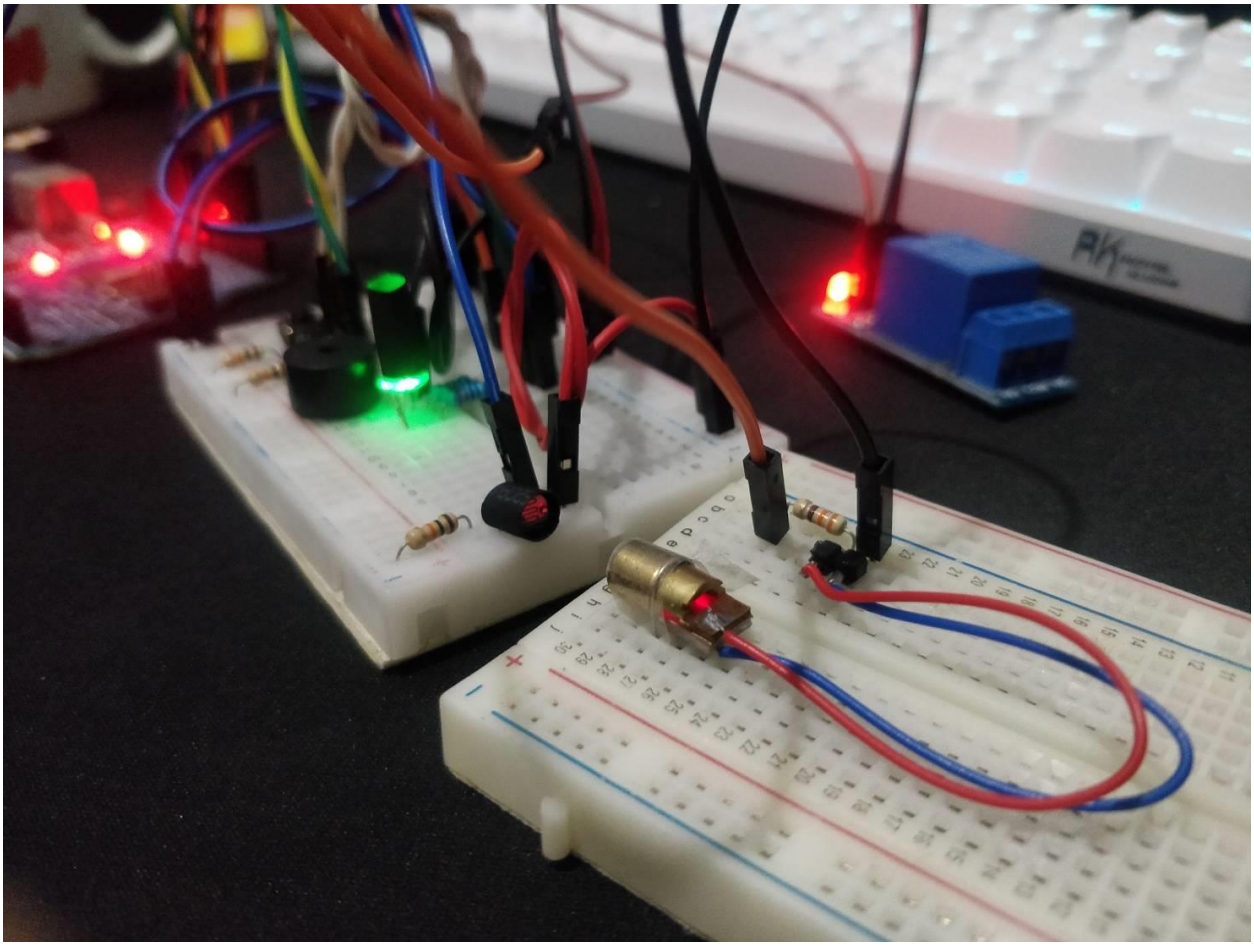
- Software design

  Input components:
  - Set button (I/O Address D4)
  - Off button (I/O Address D5)
  - Photoresistor (Analog Address A0)

  Output components:
  - RGB LED (I/O Address D8, D9, D10)

- Buzzer (I/O Address D3)
- Relay (I/O Address D6)





Conclusion

The robot has successfully passed the initial requirements and objectives that we have presented. We have also discovered some limitation during testing; mainly the sensitivity of the tripwire. Unlike the product we covered in literature studies, our tripwire model still detects non-hostile object such as leaf or other small object. Whereas the product in our literature studies have low false positive rate.