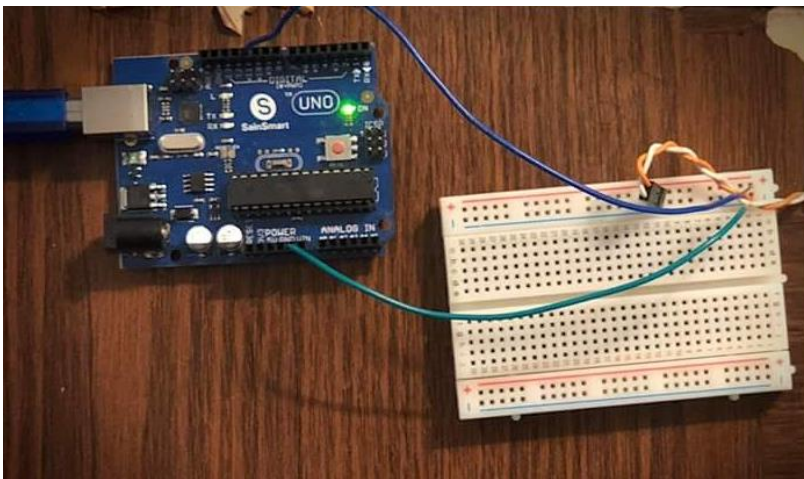


# Fiber Optic Communication

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## Abstract:

Fiber optic communication is a technology that is incredibly cheap, safe, and efficient compared to copper wire technology when used for long range communication. The technology has a long history that traces back to famous inventors such as Graham Bell. It has diverse uses and a bright future ahead of it.



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Light Messengers

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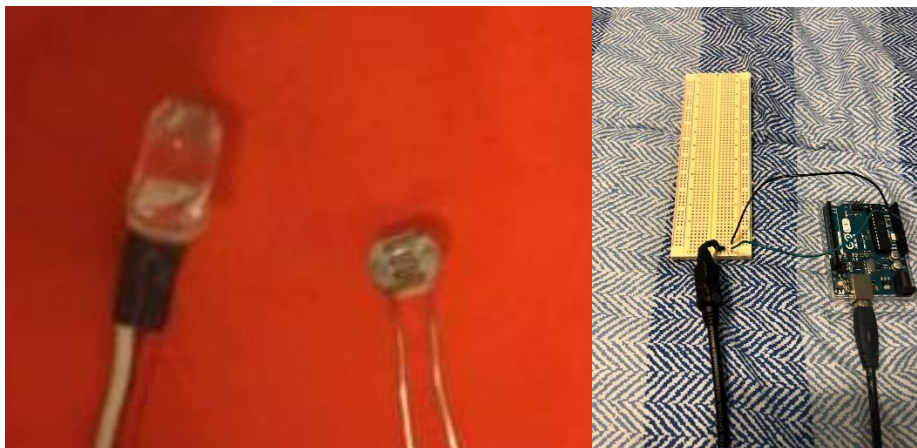
# Introduction

The basis of high speed internet relies on the fastest thing in the universe: light. The light is guided by special cables that allow the light to follow its path for miles. The intensity of light in the cable allows people to obtain digital and analog information so that people can get their Facebook page loaded in milliseconds. In addition, it allows for high information density up to 160 terabits per second, i.e. 160,000,000,000,000 pulses of light in one second. This supersedes anything that copper communication cable can do. To transmit information, the cable must have an encoder and decoder on opposite ends. The encoder takes the analog or digital signal on one side and converts it to pulses of light. The decoder receives the pulses of light and converts it back to an analog or digital signal.

## Description and Construction

### The Assembly

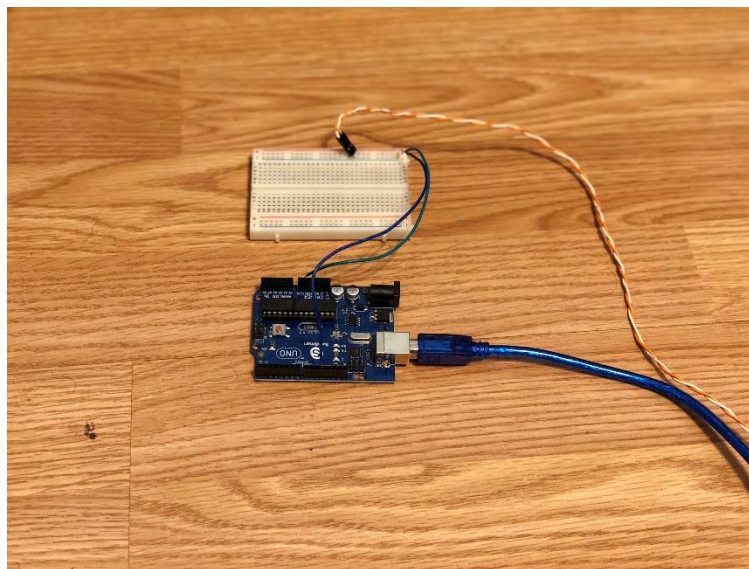
Construction of the encoder, decoder, and cable are fairly simple. First, it is necessary to obtain five items: an LED, a photoresistor, a fiber optic cable, and two Arduinos.



Once acquired, the photoresistor and LED must be taped onto the ends of the fiber optic cable so that when the LED is on, the photoresistor is illuminated.



When that is assembled, the photoresistor must be connected to pins A0 and 5V of the receiver Arduino. The LED must be connected to pins 10 and GND of the transmitter Arduino.



## The Code

### Receiver

Now that that is put together, the hardest part comes, the code. The following code must be uploaded to the receiver Arduino.

```

#define in A0
#define threshold 1015
#define del 200

void setup() {
  pinMode(in, INPUT_PULLUP);
  Serial.begin(9600);
}

void loop() {
  double pin = analogRead(in);
  int i = 6;
  int num = 0;
  if(pin > threshold){
    num += 1 << i;
    i--;
    while(i > -1){
      delay(del);
      int t = analogRead(in) > threshold ? 1 : 0;
      num += t << i;
      i--;
    }
    Serial.print(char(num));
  }
  delay(del);
}

```

This code loops until it finds a high enough voltage. Once it finds a high enough voltage, it adds a binary one to the beginning of a number, num. It waits a designated amount of time and reads again and if the voltage is low then it adds a binary zero or a binary one. It repeats this step until the number of spots is zero.

## Transmitter

However, for this to receive the signal, something must transmit it. The transmitter Arduino has the following code.

```

#define button 8
#define led 11
#define del 200

void setup() {
  pinMode(button, INPUT_PULLUP);
  pinMode(led, OUTPUT);
  Serial.begin(9600);
}

void loop() {
  if(Serial.available()){
    int letter = (int) Serial.read();
    int i = 6;
    while(i > -1){
      int a = letter >> i & 1;
      i--;
      if(a == 1){
        digitalWrite(led, HIGH);
      }
      else{
        digitalWrite(led, LOW);
      }
      delay(del);
    }
    digitalWrite(led, LOW);
  }
}

```

This code waits until a character is entered. Once the character is entered, the code goes through the bits of the ASCII (American Standard Code for Information Interchange) designated value of the character. The code writes the first character as a pulse of light if the value is one and turns the light off if the value is zero. The code waits after each value in order to accommodate the time it takes to turn the LED on and off.

## History

The principal idea behind the fiber optic cable is total internal reflection. This property was not detailed until Daniel Collodon and Jacques Babinet were able to demonstrate it the 1840's. Physicists would further this idea, but it was not until Alexander Graham Bell that this idea would be used in an invention. He made a telephone system based

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off of fiber optics in 1880, but sadly due to practicality at the time, the regular telephone would exist alone. However, audio was not enough. In the 1930s, Heinrich Lamm successfully transmitted images through fiber optics. In 1973, Bell Laboratories produced a cheaper version of the material in the cables. Furthermore, in 1986, another material was created by Payne and Desurvire. The mode of communication started its use by UK police in 1975 and by 1996, it was used for a transatlantic cable. FLAG became the biggest of these in 97 and continues to be the longest in the world.

## Current Applications

Currently, fiber optics are used for a lot. Fiber optics are mainly used in communications. This is mainly because of lack of loss over long distances and lack of electromagnetic interference. This has massive implications for military use. The military has many metal based systems so the use of electricity is not as feasible or easy as fiber optics. However, fiber optics does not simply have use in communication. Fiber is also used in the medical field as almost a light funnel. The fiber guides lights to parts of the body where it is not feasible to put a flashlight. In addition, fiber optics also can be used in sensors as it can image objects. From networks, to television, to medical, and to industrial, fiber optics are used in a variety of ways.

## Benefits to Copper

1. Energy Efficient. Copper has high resistance meanwhile glass does not.
2. Little Signal Loss. Amplifiers are only needed every 25 miles.
3. Data transfers quickly. The Marea cable transfers 160 terabits / second.
4. Copper catches on fire but fiber optics do not.

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