Wearable Multifunctional Indicator

Inventor Information

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Introduction

Our device is mainly based on two parts – a helmet and a glove. On clenching and unclenching our hand into a fist, the light turns on due to the straightening of the flex sensor, and by rotating our hand and head, the light will be projected wherever we point with the help of the steering mount. It is achieved by detection, sensors, movement control of the steering mount, and single-chip microcomputer technologies.

Figure 1 Wearing diagram

In the beginning, we wanted to achieve the goal of where the finger goes, and where the laser goes, so the main light source was placed above our heads. To obtain the hand posture, our sponsor advised that a gyroscope was the best choice, so we placed one on the glove to control the vertical movement. Of course, motion requires a steering mount, so the laser is placed on two steering mounts, one to control vertical direction and the other to horizontal. Due to the laser switch needs to be held in hand, the flex sensor can precisely meet this requirement through its characteristics. Finally, the voltage data and gyroscope signal reading require a single-chip mi microcomputer to complete, so the helmet device and glove device are connected by an SCM.

Figure 2 Key components of the device

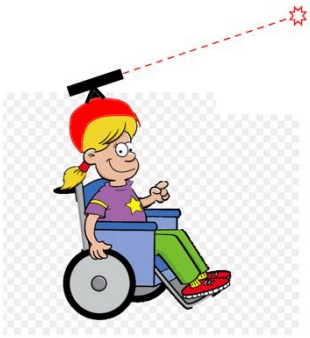
Figure 3 Finger straight to light up the laser

Figure 4 Raise the twist, then the steering mount controls laser to move upwards

Figure 5 Curve the flexor sensor to turn off the laser

Purpose

our project aims to help disabled people with handicaps, ALS, or other impairments to give instructions without making big movements or speaking. This way they will be able to move objects around or operate devices even if they are confined to the wheelchair or unable to move. For example, if the user is unable to speak, they can express their needs clearly by only making slight wrist movements to project laser light on objects out of reach. Every time they use this device just like they obtain the magic that contains beautiful fantasies and blessings. It can also provide efficiency for managers during inspections on construction projects at night, as they only need to move their hands instead of the whole arm to hold up torches.



Background Research

1.Flex sensor

We conducted background research on Arduino (flex sensor) to learn about how it functions to change magnitude of current (amprage). By flexing our fingers to change the shape of the sensor and hence its amperage, to switch the device on and off. VENKATESWARA et al.'s paper aims to use Arduino to detect the movement of fingers, thereby translating hand gestures for the disordered. This was actually our original idea; however, we chose a slightly different approach in the end, as we found it difficult to detect complex hand gestures.

YUdhana et al.'s research focuses on analyzing flex sensor response generated by movement of fingers, using gyroscope and accelerometer to define the gestures on arises representing the three dimensions. It inspired us to use the same method to capture movement of the hand and head.

2. Conducted research to find the best ways to identify movement and decided on the above-mentioned method of using the gyroscope. it calculates the specific position of the movement by obtaining data from the x, y, and z-axis. We didn't need to use data from all three axises but we decided we needed the steering mount to rotate after receiving signals from the Arduino.

3. Arduino

Papers on the single-chip microcomputer/Arduino explained how it sends and receives signals from ports. It inspired us to use the Arduino to detect the bending angle of the flex sensor and decide if the device need to be switched on or off. We made the Arduino the central processing unit of our device as it makes judgments and sends instructions to the steering mount.

Definitions

1. Single-chip microcomputer (Arduino)

It works like a miniature computer. It measures voltage, and receives and transfers the signals in the form of pulse-wide signals, through its USB, digital I/O, and analog ports, to recognize the angle control and drive the steering mount.

1. Steering mount

The steering mount is an angle control driver. In our project, it receives instructions from the micro single-chip microcomputer/Arduino to rotate angles.

2. Gyroscope

It is a device that measures rotation. In our project, it detects angle changers of the hand/finger and informs the Arduino/micro single-chip microcomputer.

4. Flex sensor

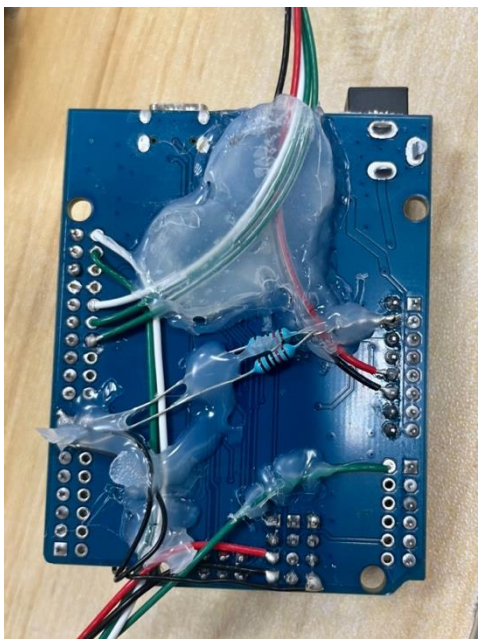
It consists of two layers, the one at the front transparent and the one at the back black and light-prove. When it bends the two layers squeeze together, causing the change in resistance and thus the voltage. This change is then detected by the Arduino.

5.Laser pen

A small device that emits a narrow beam of laser light. We chose it because it is light and small in size so easier to secure.

Process

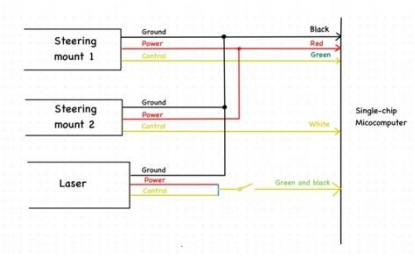
1. For convenience, we plan to put the flex sensor and the gyroscope on a glove. There are two layers of the flex sensor. When it is bent, these two metal layers squeeze against each other to change the density, so the resistance is also changed. We fixed the flex sensor on the right index finger so that the voltage can be changed by bending the finger. Also, we need to set a certain angle as a judgment signal for opening and closing. So here we will keep time to record the maximum and minimum angle for someone's finger to fit individuals in the code.

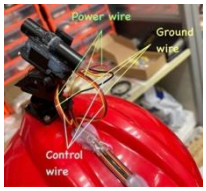


2. Then, to get the voltage of the flex sensor, we used the Single-chip microcomputer to measure the voltage by series connecting another resistance. We can't measure the voltage change in a circuit with only one flex sensor, because although you change the resistance of the flex sensor, the voltage on two sides is always 5V. So,

if we series connect another resistance, according to the principle of series voltage division, SCM can easily calculate, get the change of data, and control the switch of the laser.

3. Another part of the device on the glove is the gyroscope, which is used to control the direction of the laser. A gyroscope is a device that can detect the inclination angle of objects. When It is placed on the back of the hand, it can detect the direction of the human arm in real-time. The single-chip microcomputer controls the motion of the steering mount based on the direction information of the human arm detected by the gyroscope, thereby achieving the goal of laser tracking the direction of the arm.





4. The device on the helmet includes a laser pen and two steering mounts. Each of these units contains three wires: black ground wire, red power wire, and yellow control wire. Actually, we did not use the second steering mount to control the horizontal change of direction in the end, but we also integrated it for further improvement. As we don't need the yellow wire of the laser that is used to control light intensity, we directly connect it with the power wire, just as a common wire. We connect all of these three ground wires together and connect power wires of two steering mounts to the SCM. Their control lines are respectively connected to the corresponding positions on the SCM.

Further exploration & Application

We hope to simplify our device to make it easier to carry around and improve its appearance. The wires may get in the way when we use our project in real life.

Also, we want to make adjustments so that when we will be able to move the light left and right by flexing our arms instead of hand, to allow for more complicated movements. To solve this issue, we can apply a gyroscope on the arm to detect rotations.

We also hope to translate advanced sign language and other gestures by using angle recognition on the fingers so our project can be of better use in daily life instead of simply used for instructions and directions.

After our second experiment when we put on the glove to find the steering mount responding to the movement of our hand which was unintended and very distracting, we decided we needed other assisting tools to directly control the switching on and off of the laser pen and steering mount. Also, when taking off the glove, we were unable to turn off the light because we programmed it remain on when the flex sensor stays straight.

*We later added two switches to control the laser and the steering mount. The switch connection also requires a resistor, because the two wires of the switch, one plugged into the ground wire on the SCM and the other requiring the connection of a stable voltage. So we need a resistor to introduce a voltage of five volts because the voltage hanging on the other end of the switch is very

unstable. Here we did not use just a wire because if the wire and the other end of the switch come into contact, a short circuit will occur, which will burn out the entire working device. However, if a resistor is connected, one end is 5 volts and the other end is 0, even if they come into contact, there will be no safety issues.

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