Project name: Kinesis : An intuitive mouse interface

Author: Apostol Andrei Constantin

Purpose: User input devices have mainly consisted of mouse, keyboard and joysticks. However, with VR and AR swiftly emerging on the market, it is paramount to explore new designs that can offer a more immersive experience and allow us to fully benefit from these technologies. Currently, most VR headsets do not include a controller, and those that do are either prohibitively expensive or offer an unidimensional experience.
The Kinesis Project proposes an affordable and intuitive mouse interface, which is designed as a wearable glove that can emulate all mouse functions (left click, right click, click hold, drag&drop, movement and scrolling) using only the user's hand gestures. Since some variation is involved, such as hand size, finger size and how the user wears the device, the glove is designed to calibrate and adapt to each specific user.
Its main use cases are for gaming and digital art.

Requirements:

- 1x Arduino Pro Micro (or any ATMEGA32U4 compatible board)
- 1x MPU-6050 Gyroscope & Accelerometer Module
- 1x Button
- 1x Breadboard 60p
- 3x 2.2 Inch Flex Sensor
- 1x standard glove

Optional:

Protoboard/PCB

Cost: Aprox. 50 USD. (eBay)

We have only identified one similar product : the Nintendo PowerGlove, which is a controller designed for the Nintendo NES platform, which is a retired system. Price range for a pre-owned PowerGlove is 100+$.
As of now, no similar product exists on the market.

Project description:
The glove contains flex sensors sewn to the index, middle and ring finger. Index finger is used for left-click, middle-finger for right click and the ring finger is used for scrolling
The user should equip the Kinesis Glove and connect it to a PC. After connection, the RX and TX leds will blink, signaling the calibration phase is about to begin. During this period, the hand

should be held in a comfortable position. Once the leds stop blinking, the board reads the initial hand position and the calibration phase begins. During this phase (lasts aprox. 2 seconds) the user should clench and release his fist for a few times, as to determine the flexing range. The program then computes thresholds for left and right click, relative to the flexing range.

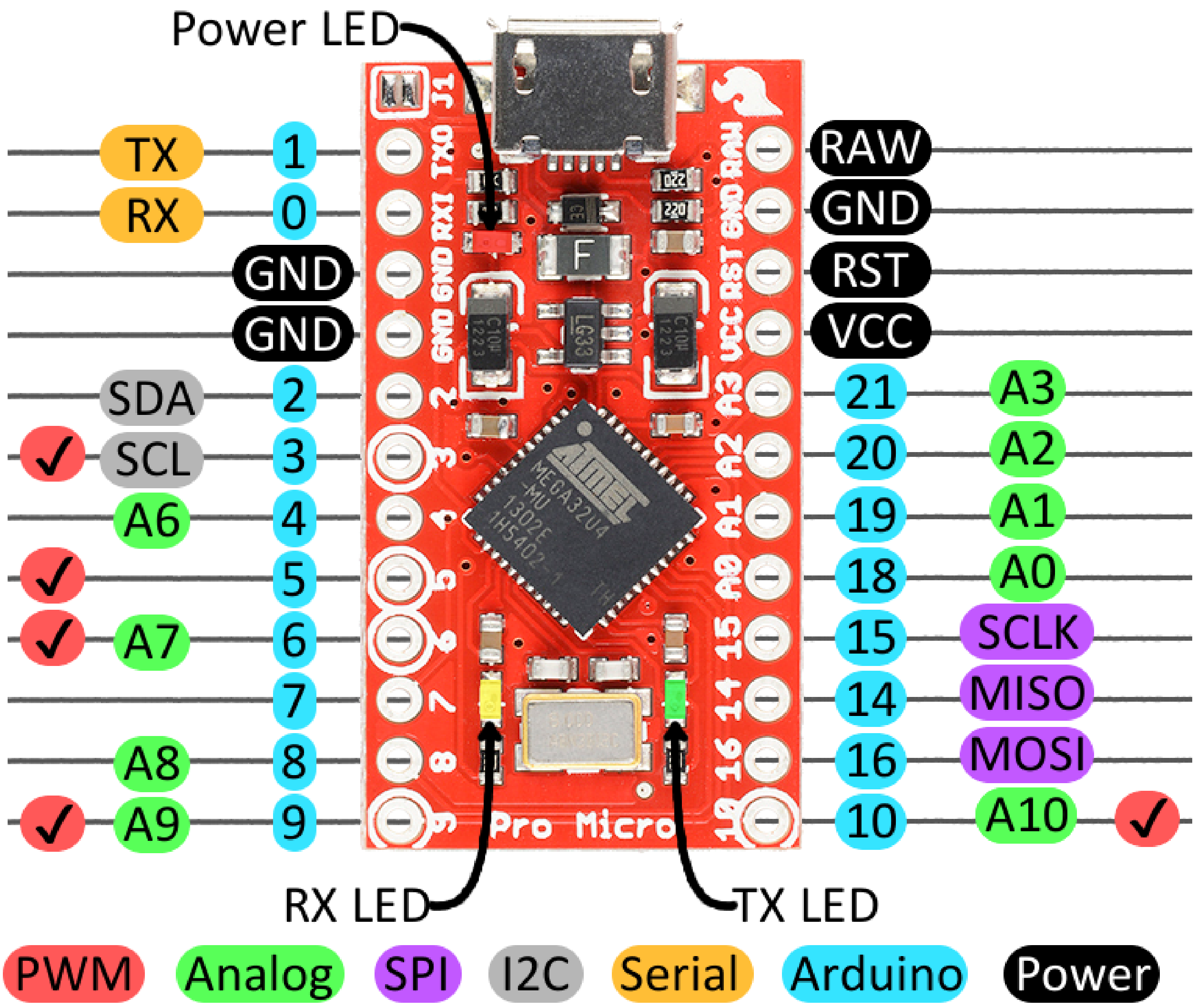
Let min_i denote the minimum value read from sensor i,
max_i denote the maximum value read from sensor i,
where $i \in 1,2$
then, the formula used to calculate the threshold is
$min_i + s * (max_i - min_i)$
where $s \in [0,1]$ is a variable sensitivity factor.

Low values of s determine low sensitivity, which means the user should make very ample gestures in order for actions to be triggered. Similarly, high values of s determine high sensitivity, meaning the user is only required to make “tap”-like gestures for clicks to be effected.
Currently, s is set to 0.7 for both. This value has been determined experimentally and has been chosen as a compromise between comfort and control. Feel free to tweak this value to your liking.
The scroll sensor (mounted on ring finger) is activated only relative to the initial position determined when calibration phase begins. Current threshold settings are:
$init-40$ for scrolling down
$init+15$ for scrolling up,
where $init$ is the initial position.

Mouse movement is done via the values read from the MPU-6050 module through I2C. At each step, the mouse is moved relative to its current position. The formula used to determine the mouse movement is the following:
$$dist_x = -(g_x + 300)/200$$
$$dist_y = (g_z - 100)/200$$
where $dist_x$ and $dist_y$ are the distance the mouse moves on the X and Y axis respectively, and g_x and g_z values read from the gyroscope’s X and Z axis. The module’s orientation on the breadboard means there isn’t a 1:1 correspondence between screen and gyroscope axis, which is why we move in reverse on the X axis and use the Z axis instead of Y.
The added corrections are done to map the values correctly. To increase or decrease mouse sensitivity, simply tweak the value by which it is divided (currently 200).

If calibration has not been done properly or the user wants to remove the glove without losing control of the mouse, the user can press the Reset button. Resetting will make the ProMicro enter Bootloader Mode, meaning it may take up to 8 seconds for it to start up.

Connections: To establish I2C communication, we need to connect the SCL and SDA pins of the Arduino Pro Micro and the MPU-6050. Flex sensor connections are just as easy.



Arduino ProMicro

VCC → +5V
GND → Common GND
Add a button between GND and RST pins.

MPU6050

VCC → +5V
GND → Common GND
SDA → ProMicro 2
SCL → ProMicro 3
INT → ProMicro 7

Flex sensor → Arduino

VCC → +5V
GND → Common GND
OUT → ProMicro AnalogPin (left→A0, mid→A1, right→A2)

Source code: You cand find the entire commented source code in this repo: https://github.com/AndreiXYZ/ProiectArduino

Improvements & future considerations: Although presenting good potential, the Kinesis Glove is still in its early stages of development and could use further improvements.
Here are some future considerations for this project:

- Wireless communication (IR/BLE)
- Potentiometer to fine-tune sensitivity on the fly
- Add encasing