Creating a digital switch based on the output of the GPIO ports of the Beagle Board that turns a USB port on or off

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Abstract: The Beagle Board GPIO ports can be controlled to output a 1.8V signal. This allows for the signal to be a controller to turn on or off devices using a switch. Connecting the switch to a USB port will allow the USB to be turned on and off as desired, which would then turn on or off the device that is connected to the USB port.

Creation of the switch

A simple switch can be created using a transistor and a few other circuitry elements.

For this application, a TIP31A NPN transistor was chosen to be the basis for the switch. The transistor must then be attached to the appropriate places in order for the switch to work as intended. The transistor has three different pins that must be attached. The switch will require no other connections besides connects between the Beagle Board and the peripheral that it is attached to. This includes no external power supply or ground, such as a battery. To operate the Beagle Board, it must be connect by an AC adapter that gives the Beagle Board a 5V voltage and also a ground.

The emitter of the TIP31A is connected to the ground from the Beagle Board. The collector is connected to peripheral device which can be turned on or off based on the switch. The base must then be connected to the signal that is desired to control the switch, along with some control resistor to ensure the transistor does not receive too high a voltage or current. A 100Ω resistor is connected to the base of the transistor. The control of the switch will be the voltage that is sent from the GPIO ports of the Beagle Board. A GPIO port is connected to the resistor.

![Figure 1: TIP31A switch](image-url)
When the GPIO is off, no current or voltage is emitted. This places the transistor into cutoff and makes an open circuit. When the GPIO port sends the 1.8V, the transistor becomes saturated, creating a closed switch. This allows for a complete circuit and the peripheral device can be turned on. After testing, the switch itself comes on at a voltage of .71V and turns off at a .65V. Since the GPIO either sends a 0V or 1.8V signal that is not a problem.

**Switch and USB integration**

To easily integrate many devices with the Beagle Board, the switch is to be connected to a USB port. Since the switch controls just the power portions of the USB, that is all that will be covered. Another circuit would have to be created to control any data that would be sent to and from the USB ports and that would include the D- and D+ lines of the USB. The only wires needed for the power on or off for the USB are the ground (black) wire and the power (red) wire. A female USB connector is what will be used and connected to the switch. This is because many products, especially for computers, are normal male connectors. The male connectors can be easily attached without the need for a converter. The ground wire is connected to the collector of the switch to allow the ground to be connected once the switch closes. The power wire is connected to the 5V source that comes from the Beagle Board.

![Figure 2: Switch-USB integration](image)

**Summary**

There is a need to connect peripheral devices to the Beagle Board. For this connection, it is necessary to be able to control the peripherals using coding we can implement strictly on the Beagle Board. For this, the GPIO ports can be used to send a controlling signal that controls whether a switch is open or closed. It is also needed that the circuitry not needs any external source of power. Since many devices use a USB connection, creating a switch that controls a USB port that any device can be attached to is an effective way for controlling peripheral devices attached to the Beagle Board.