

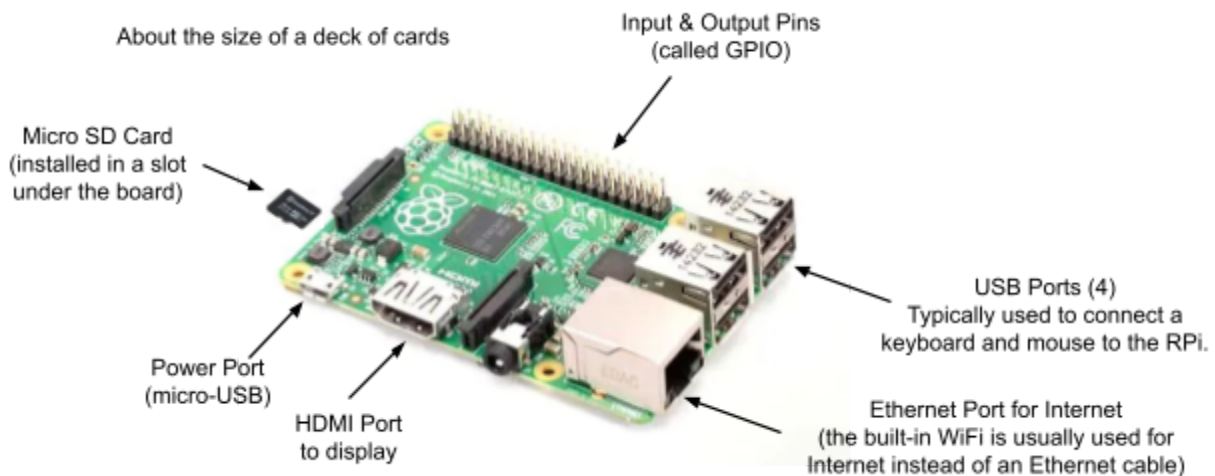
How KegLevel Monitor Works

A non-technical explanation

These are the components, connections, and processes used by KegLevel Monitor:

- The Raspberry Pi Microcomputer
- The Flow Sensor
- The Wiring & Connections
- The Display and Calculations

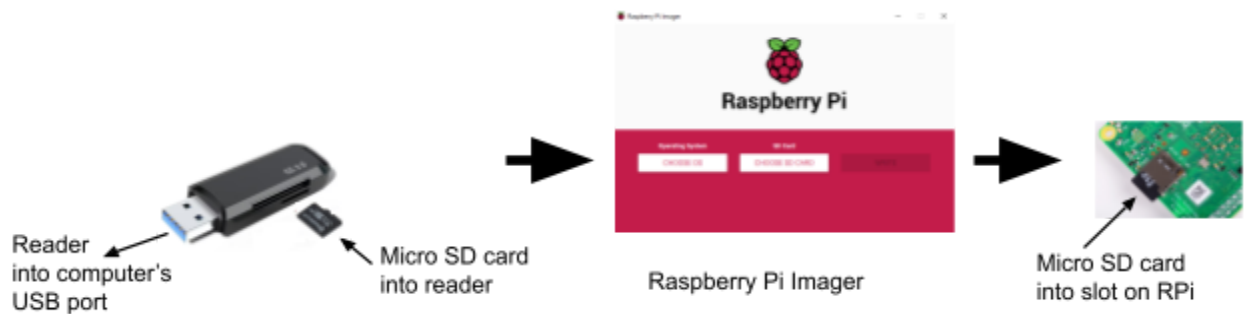
Raspberry Pi Microcomputer



The Raspberry Pi Microcomputer (RPi) is the “brains” of the system. It is a very small computer, about the size of a deck of cards. It connects to an HDMI display, and its graphical user interface looks and feels like a Windows or Mac computer. The KegLevel Monitor app runs on the RPi, and all of the app’s information is shown on the HDMI display. The flow sensors connect to the RPi, which reads the flow data from the sensors. The KegLevel Monitor app uses that flow data to calculate how much beer is left in the kegs.

Here is a brief overview the RPi connections and how it works:

- The **Micro SD Card** is like the hard drive in a computer. It stores the operating systems, the programs, and all of the files. The operating system for the RPi is free. There is a simple tool that can be downloaded onto a Windows or Mac computer called Raspberry Pi Imager. RPi Imager uses the Windows or Mac computer to put the RPi operating system onto the Micro SD card:

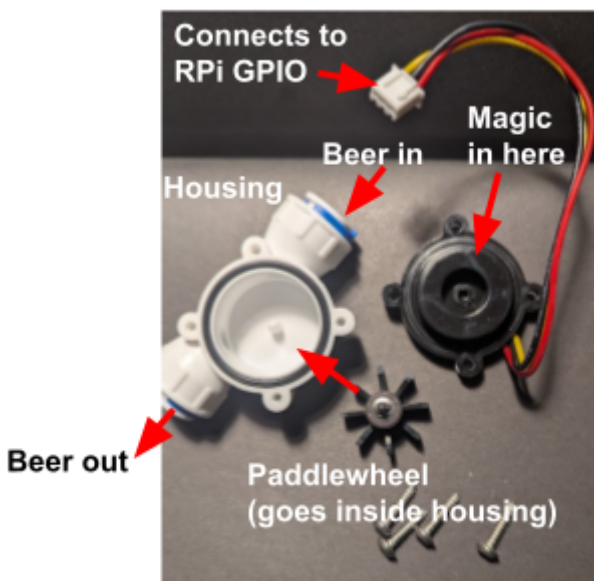


- The Micro SD card is plugged into a reader and the reader is plugged into the computer's USB port;
- RPi Imager is run to copy the RPi's operating system onto the Micro SD card;
- The Micro SD card is removed from the reader and plugged into the Micro SD card slot on the RPi.



- The **Power Port** provides the connection for power to the RPi. A power cube plugs into the AC outlet in the wall, and its micro-USB connector plugs into the Power port.
- The **HDMI port** connects to a display just like the HDMI port on a desktop computer connects to a display. There is another way to “remotely” see what is on the display, whether or not there is a display physically connected to the RP, but more on that later.
- The **Ethernet Port for Internet** *could* be connected to an Ethernet cable for Internet connectivity. However, the built-in WiFi capability of the RPi is typically used for Internet connectivity. Internet connectivity is needed to most effectively use KegLevel Monitor.
- The **USB Ports** allow USB devices to be plugged into the RPi. A keyboard and mouse typically connect to the RPi using small wireless transceivers (dongles). The RPi will automatically detect when a keyboard or mouse is plugged into the USB ports, just like a Windows or Mac computer.
- The **Input & Output pins** (called GPIO or General Purpose Input/Output) receive information from sensors and send control signals to indicators or actuators. The KegLevel Monitor has flow sensors that are connected to input pins to receive flow data from the flow sensors. The KegLevel Monitor app does not currently use any indicators or actuators. But since we're in this deep, an indicator might be an LED light that turns on when a certain condition has been detected by an app. An actuator might be a relay that turns a motor on or off when a certain condition has been detected by an app.

Flow Sensor



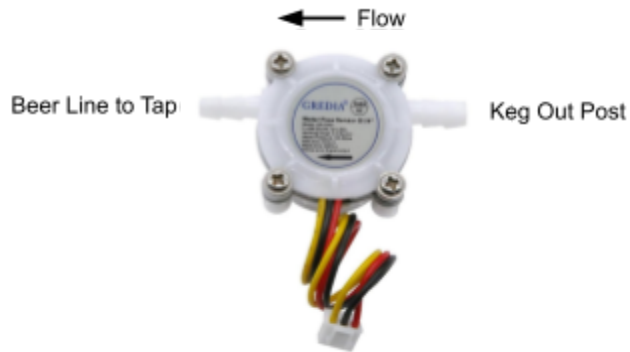
The flow sensor measures the flow of beer passing through it. There is a small paddlewheel that turns as beer goes through the sensor housing. There is magic inside the flow sensor that converts the rotating paddlewheel into electrical pulses. There is a correlation between the amount of beer (volume) passing through the sensor and the speed at which it passes through. Therefore the more beer that passes through the sensor, the faster the beer passes through the sensor, the faster the paddle wheel turns, the more electrical pulses are generated. The RPi counts the number of pulses and calculates the volume of beer that has been poured.

For example, if a half liter of beer passes through the sensor, 3000 pulses might be generated. The RPi counts 3000 pulses, the KegLevel Monitor app knows that 3000 pulses equals a half liter, and the app calculates a half liter of beer has been poured.

Of course not every sensor, even the same brand and model, will generate exactly the same number of pulses for exactly the same poured volume. Each sensor needs to be calibrated so the app knows for a given sensor, how many pulses equals how much poured volume. The app has an easy-to-use calibration feature for this purpose. Once a sensor has been calibrated it will likely “hold” its calibration factor for a long time. If remaining keg volumes begin to change then the sensor can be recalibrated. For example, a tap might be spot-on for a while, where the keg empties right when the KegLevel Monitor said the keg was empty. If that tap begins to show remaining volume when it’s really empty, the sensor should probably be recalibrated.

It is possible that gunk pulled out of the keg could foul the paddlewheel, especially if dry hopping in the keg. A fouled paddlewheel could cause incorrect readings. Many sensors such as the one shown above can be taken apart for cleaning, some cannot. It is good practice to prevent (most) gunk from getting to the sensor by using a dip tube with fine-micron screens. Many floating dip tubes have fine micron screens.

The easiest way to sanitize the flow sensor is to fill a spare keg with some sanitizing solution, slightly pressurize the keg, attach the beer fitting to the keg's out post, and run some solution through. It is good practice to do this just before tapping a new keg. Then run beer from the new keg through the tap right away to clear the sanitizing solution from the sensor, beer line, and tap.



The flow sensor has two types of connections: Liquid and Electrical.

- The liquid connection is made inline with the beer line, typically as close as possible to the Out post on the keg.
- The electrical connection is 3 wires coming from the sensor that are connected to the RPi:
 - Voltage in (VIN) Red - all flow sensors are connected to the same GPIO voltage pin at the RPi.
 - Ground (GND) Black - all flow sensors are connected to the same GPIO ground pin at the RPi.
 - Signal (SIGNAL) Yellow - each flow sensor is connected to a specific GPIO pin at the RPi. The KegLevel Monitor app knows which pin represents which tap. When the signal line from a sensor is connected to the specific GPIO pin that is identified for Tap 1, then any pulses detected at that pin are known to the app to belong to Tap 1.

Each tap has one flow sensor. So Tap 1 will have Flow Sensor 1, Tap 2 will have Flow Sensor 2, etc. A kegerator with 3 taps (3 kegs) would have three flow sensors. Logically to the KegLevel Monitor app, a Tap is a Flow Sensor and vice-versa.

Wiring & Connections

Display and Calculations