Linux Gamepad Specification
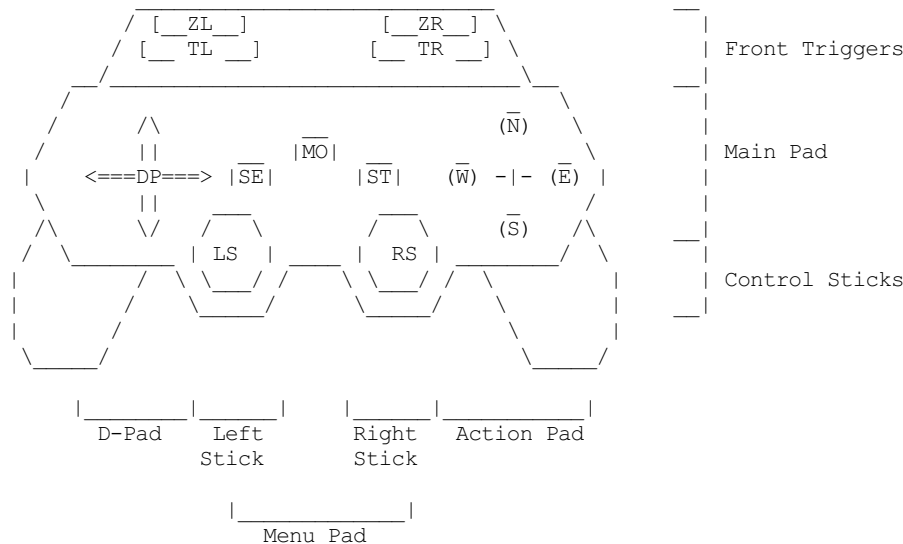
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Introduction

Linux provides many different input drivers for gamepad hardware. To avoid having user-space deal with different button-mappings for each gamepad, this document defines how gamepads are supposed to report their data.

Geometry

As "gamepad" we define devices which roughly look like this:

```
              _____                    __
             / [__ZL__]        [__ZR__] \                  |
            / [__ TL __]        [__ TR __] \                 | Front Triggers
          __/_____             __|
         /                                       \             |
        /         /\                        _       \          |
       /          ||           __          (N)       \        | Main Pad
      /           ||        |MO|  __                   \        |
     |    <===DP===> |SE|       |ST|    (W) -|- (E)  |          |
      \           ||        ___         ___          /          |
      /\          \/    /       \      /       \    (S)   /\       __|
     /  _____| LS  |____ | RS |_____/  \           |
     |       /  \ \___/ /   \ \___/ /  \             |      | Control Sticks
     |      /      \____/      \____/      \         |        __|
     |     /                               \         |
      \____/                                \____/
```

```
      |_____|____|   |_____|_____|
       D-Pad   Left      Right   Action Pad
               Stick     Stick
```

```
               |_____|
                 Menu Pad
```

Most gamepads have the following features:

- Action-Pad 4 buttons in diamonds-shape (on the right side). The buttons are differently labeled on most devices so we define them as NORTH, SOUTH, WEST and EAST.
- D-Pad (Direction-pad) 4 buttons (on the left side) that point up, down, left and right.
- Menu-Pad Different constellations, but most-times 2 buttons: SELECT - START Furthermore, many gamepads have a fancy branded button that is used as special system-button. It often looks different to the other buttons and is used to pop up system-menus or system-settings.
- Analog-Sticks Analog-sticks provide freely moveable sticks to control directions. Not all devices have both or any, but they are present at most times. Analog-sticks may also provide a digital button if you press them.
- Triggers Triggers are located on the upper-side of the pad in vertical direction. Not all devices provide them, but the upper buttons are normally named Left- and Right-Triggers, the lower buttons Z-Left and Z-Right.
- Rumble Many devices provide force-feedback features. But are mostly just simple rumble motors.

Detection

All gamepads that follow the protocol described here map BTN_GAMEPAD. This is an alias for BTN_SOUTH/BTN_A. It can be used to identify a gamepad as such. However, not all gamepads provide all features, so you need to test for all features that you need, first. How each feature is mapped is described below.

Legacy drivers often don't comply to these rules. As we cannot change them for backwards-compatibility reasons, you need to provide fixup mappings in user-space yourself. Some of them might also provide module-options that change the mappings so you can advise users to set these.

All new gamepads are supposed to comply with this mapping. Please report any bugs, if they don't.

There are a lot of less-featured/less-powerful devices out there, which re-use the buttons from this protocol. However, they try to do this in a compatible fashion. For example, the "Nintendo Wii Nunchuk" provides two trigger buttons and one analog stick. It reports them as if it were a gamepad with only one analog stick and two trigger buttons on the right side. But that means, that if you only support "real" gamepads, you must test devices for _all_ reported events that you need. Otherwise, you will also get devices that report a small subset of the events.

No other devices, that do not look/feel like a gamepad, shall report these events.

Events

Gamepads report the following events:

- Action-Pad:

  Every gamepad device has at least 2 action buttons. This means, that every device reports BTN_SOUTH (which BTN_GAMEPAD is an alias for). Regardless of the labels on the buttons, the codes are sent according to the physical position of the buttons.

  Please note that 2- and 3-button pads are fairly rare and old. You might want to filter gamepads that do not report all four.

    - 2-Button Pad:

      If only 2 action-buttons are present, they are reported as BTN_SOUTH and BTN_EAST. For vertical layouts, the upper button is BTN_EAST. For horizontal layouts, the button more on the right is BTN_EAST.

    - 3-Button Pad:

      If only 3 action-buttons are present, they are reported as (from left to right): BTN_WEST, BTN_SOUTH, BTN_EAST If the buttons are aligned perfectly vertically, they are reported as (from top down): BTN_WEST, BTN_SOUTH, BTN_EAST

    - 4-Button Pad:

      If all 4 action-buttons are present, they can be aligned in two different formations. If diamond-shaped, they are reported as BTN_NORTH, BTN_WEST, BTN_SOUTH, BTN_EAST according to their physical location. If rectangular-shaped, the upper-left button is BTN_NORTH, lower-left is BTN_WEST, lower-right is BTN_SOUTH and upper-right is BTN_EAST.

- D-Pad:

  Every gamepad provides a D-Pad with four directions: Up, Down, Left, Right Some of these are available as digital buttons, some as analog buttons. Some may even report both. The kernel does not convert between these so applications should support both and choose what is more appropriate if both are reported.

    - Digital buttons are reported as:

      BTN_DPAD_*

    - Analog buttons are reported as:

      ABS_HAT0X and ABS_HAT0Y

  (for ABS values negative is left/up, positive is right/down)

- Analog-Sticks:

  The left analog-stick is reported as ABS_X, ABS_Y. The right analog stick is reported as ABS_RX, ABS_RY. Zero, one or two sticks may be present. If analog-sticks provide digital buttons, they are mapped accordingly as BTN_THUMBL (first/left) and BTN_THUMBR (second/right).

  (for ABS values negative is left/up, positive is right/down)

- Triggers:

  Trigger buttons can be available as digital or analog buttons or both. User- space must correctly deal with any situation and choose the most appropriate mode.

  Upper trigger buttons are reported as BTN_TR or ABS_HAT1X (right) and BTN_TL or ABS_HAT1Y (left). Lower trigger buttons are reported as BTN_TR2 or ABS_HAT2X (right/ZR) and BTN_TL2 or ABS_HAT2Y (left/ZL).

  If only one trigger-button combination is present (upper+lower), they are reported as "right" triggers (BTN_TR/ABS_HAT1X).

  (ABS trigger values start at 0, pressure is reported as positive values)

- Menu-Pad:

  Menu buttons are always digital and are mapped according to their location instead of their labels. That is:

    - 1-button Pad:

      Mapped as BTN_START

    - 2-button Pad:

      Left button mapped as BTN_SELECT, right button mapped as BTN_START

  Many pads also have a third button which is branded or has a special symbol and meaning. Such buttons are mapped as BTN_MODE. Examples are the Nintendo "HOME" button, the XBox "X"-button or Sony "PS" button.

- Rumble:

Rumble is advertised as FF_RUMBLE.