

1 V4L2 简介

video4linux2 (V4L2) 是 Linux 内核中关于视频设备的内核驱动，它为 Linux 中视频设备访问提供了通用接口，在 Linux 系统中，V4L2 驱动的 Video 设备节点路径通常 /dev/video/ 中的 videoX

V4L2 驱动对用户空间提供字符设备，主设备号为 81，对于视频设备，其次设备号为 0-63。除此之外，次设备号为 64-127 的 Radio 设备，次设备号为 192-223 的是 Teletext 设备，次设备号为 224-255 的是 VBI 设备

V4L2 驱动的 Video 设备在用户空间通过各种 ioctl 调用进行控制，并且可以使用 mmap 进行内存映射

1.1 V4L2 驱动主要使用的 ioctl

命令值如下所示：

```
-----
#define VIDIOC_QUERYCAP _IOR('V', 0, struct v4l2_capability) /*查询能力*/
#define VIDIO_G_FMT _IOWR('V', 4, struct v4l2_format) /*获得格式*/
#define VIDIOC_S_FMT _IOWR('V', 5, struct v4l2_format) /*设置格式*/
#define VIDIOC_REQBUFS _IOWR('V', 8, struct v4l2_requestbuffers) /*申请内存*/
#define VIDIOC_G_FBUF _IOW('V', 10, struct v4l2_framebuffer) /*获得Framebuffer*/
#define VIDIOC_S_BUF _IOW('V', 11, struct v4l2_framebuffer) /*设置Framebuffer*/
#define VIDIOC_OVERLAY _IOW('V', 14, int) /*设置Overlay*/
#define VIDIOC_QBUF _IOWR('V', 15, struct v4l2_buffer) /*将内存加入队列*/
#define VIDIOC_DQBUF _IOWR('V', 17, struct v4l2_buffer) /*从队列取出内存*/
#define VIDIOC_STREAMON _IOW('V', 18, int) /*开始流*/
#define VIDIOC_STREAMOFF _IOW('V', 19, int) /*停止流*/
#define VIDIOC_G_CTRL _IOWR('V', 27, struct v4l2_control) /*得到控制*/
#define VIDIOC_S_CTRL _IOWR('V', 28, struct v4l2_control) /*设置控制*/
-----
```

1.2 重要结构

头文件 include/linux/videodev2.h

include/media/v4l2-dev.h

V4L2 驱动核心实现文件：driver/media/video/v4l2-dev.c

v4l2-dev.h 中定义的 video_device 是 V4L2 驱动程序的核心数据结构

```
struct video_device
{
    const struct v4l2_file_operations *fops;
    struct cdev *cdev; //字符设备
    struct device *parent; //父设备
    struct v4l2_device *v4l2_dev; //父 v4l2_device
    char name[32]; //名称
    int vfl_type; //类型
    int minor; //次设备号
    /*释放回调*/
    void (*release)(struct video_device *vdev);
    /*ioctl 回调*/
    const struct v4l2_ioctl_ops *ioctl_ops;
}
```

常用的结构

参见/include/linux/videodev2.h

1)设备能力结构

```
struct v4l2_capability
{
    __u8 driver[16]; //驱动名
    __u8 card[32]; //例如 Hauppauge winTV
    __u8 bus_info[32]; //PCI 总线信息
    __u32 version; //内核版本
    __u32 capabilities; //设备能力
    __u32 reserved[4];
};
```

2)数据格式结构

```
struct v4l2_format
{
    enum v4l2_buf_type type; //本结构的数据类型
};
```

3)像素格式结构

```
struct v4l2_pix_format
{
    __u32 width; //宽度
    __u32 height; //高度
}
```

4)请求缓冲

```
struct v4l2_requestbuffers
{
    __u32 count; //缓存数量
}
```

```

        enum v4l2_buf_type type; //数据流类型
    }
    5)数据流类型包括 V4L2_MEMORY_MMAP 和 V4L2_MEMORY_USERPTR
    enum v4l2_memory{

};

```

2 V4L2 驱动注册

2.1 video_register_device

video4linux2 驱动程序的注册 drivers/media/video

video_register_device 函数用来注册一个 v4l 驱动程序

```

int video_register_device(struct video_device *vdev, int type, int nr)
{
    return __video_register_device(vdev, type, nr, 1);
}

```

其中参数 type 支持的类型如下

```

#define VFL_TYPE_GRABBER 0 //视频
#define VFL_TYPE_VBI 1 //从视频消隐的时间取得信息的设备
#define VFL_TYPE_RADIO 2 //广播
#define VFL_TYPE_VTX 3 //视传设备
#define VFL_TYPE_MAX 4 //最大值

```

----->返回调用 __video_register_device()

__video_register_device 函数先检查设备类型，接下来寻找一个可用的子设备号，最后注册相应的字符设备

```

static int __video_register_device(struct video_device *vdev, int type, int nr, int
warn_if_nr_in_use)
{

```

```

    switch (type) {
        case VFL_TYPE_GRABBER:
            minor_offset = 0;
            minor_cnt = 64;
            break;
        case VFL_TYPE_RADIO:
            minor_offset = 64;
            minor_cnt = 64;
            break;
        case VFL_TYPE_VTX:
            minor_offset = 192;
            minor_cnt = 32;

```

```

        break;
    case VFL_TYPE_VBI:
        minor_offset = 224;
        minor_cnt = 32;
        break;
    nr = devnode_find(vdev, nr == -1 ? 0 : nr, minor_cnt);
}
nr = devnode_find(vdev, nr == -1 ? 0 : nr, minor_cnt);
vdev->cdev->ops = &v4l2_fops;
//注册字符设备
ret = cdev_add(vdev->cdev, MKDEV(VIDEO_MAJOR, vdev->minor), 1);
ret = device_register(&vdev->dev);
//注册完毕设备信息存储在 video_device 数组中
mutex_lock(&videodev_lock);
video_device[vdev->minor] = vdev;
mutex_unlock(&videodev_lock);
}

```

2.2 v4l2_fops 接口

v4l2_fops 为 video4linux2 设备提供了统一的应用层接口，v4l2_fops 定义如下

```

static const struct file_operations v4l2_fops = {
    .owner = THIS_MODULE,
    .read = v4l2_read,
    .write = v4l2_write,
    .open = v4l2_open,
    .get_unmapped_area = v4l2_get_unmapped_area,
    .mmap = v4l2_mmap,
    .unlocked_ioctl = v4l2_ioctl,
    .release = v4l2_release,
    .poll = v4l2_poll,
    .llseek = no_llseek,
};

```

v4l2_fops 中的成员函数最终要调用 struct video_device->fops 中相应的成员
struct video_device->fops 是具体 video4linux2 摄像头驱动程序必须实现的接口

```

static ssize_t v4l2_read(struct file *filp, char __user *buf, size_t sz, loff_t *off)
{
    return vdev->fops->read(filp, buf, sz, off);
}

```

2.3

/drivers/media/video/samsung/fimc/s3c_fimc_core.c

驱动探测函数 s3c_fimc_probe 定义

```
static int s3c_fimc_probe(struct platform_device *dev)
```

```
{
    ctrl = s3c_fimc_register_controller(pdev);

    clk_enable(ctrl->clock); //使能时钟
    //注册 V4L2 驱动
    ret = video_register_device(ctrl->vd, VFL_TYPE_GRABBER, ctrl->id);
}
```

s3c_fimc_register_contoller 函数主要用来分配资源与申请中断

```
static struct s3c_fimc_control *s3c_fimc_register_controller(struct platform_device *pdev)
```

```
{
    ctrl->vd = &s3c_fimc_video_device[id];
    //申请中断
    ctrl->irq = platform_get_irq(pdev, 0);
    if(request_irq(ctrl->irq, s3c_fimc_irq, IRQF_DISABLED, ctrl->name, ctrl))
        return NULL;
};

struct video_device s3c_fimc_video_device[S3C_FIMC_MAX_CTRLIS] = {
    [0] = {
        .vfl_type = VID_TYPE_OVERLAY | VID_TYPE_CAPTURE | VID_TYPE_CLIPPING
        | VID_TYPE_SCALES,
        .fops = &s3c_fimc_fops,
        .ioctl_ops = &s3c_fimc_v4l2_ops,
        .release = s3c_fimc_vdev_release,

        .name = "sc3_video0",
    },
}
```

s3c_fimc_v4l2_ops,是在 drivers/media/video/samsung/fimc 中实现的 v4l2_ioctl_ops, 在用户空间进行 ioctl 等调用时, 要调用到具体实现的各个函数指针

3 V4L2 操作

3.1 s3c_fimc_open

```
static int s3c_fimc_open(struct file *filp)
```

```
{
```

```

struct s3c_fimc_control *ctrl;
int id, ret;

id = 0;
ctrl = &s3c_fimc.ctrl[id];
mutex_lock(&ctrl->lock);
if (atomic_read(&ctrl->in_use)) {
    ret = -EBUSY;
    goto resource_busy;
} else {
    atomic_inc(&ctrl->in_use);
    s3c_fimc_reset(ctrl);
    filp->private_data = ctrl;
}
mutex_unlock(&ctrl->lock);
return 0;
resource_busy:
    mutex_unlock(&ctrl->lock);
    return ret;
}

```

用户空间
 打开设备文件
 fd = open(dev_name, O_RDWR | O_NONBLOCK, 0);

3.2 获取设备的 **capability**,查看设备有什么功能

1) 结构体

```

struct v4l2_capability cap;
ret = ioctl(fd, VIDIOC_QUERYCAP, &cap);
#include/linux/videodev2.h
struct v4l2_capability {
    __u8    driver[16];    /* i.e. "bttv" */
    __u8    card[32]; /* i.e. "Hauppauge WinTV" */
    __u8    bus_info[32]; /* "PCI:" + pci_name(pci_dev) */
    __u32    version;      /* should use KERNEL_VERSION() */
    __u32    capabilities; /* Device capabilities */
    __u32    reserved[4];
};

```

2) 驱动实现

```

static int s3c_fimc_v4l2_querycap(struct file *filp, void *fh,
                                   struct v4l2_capability *cap)
{
    struct s3c_fimc_control *ctrl = (struct s3c_fimc_control *) fh;

```

```

strcpy(cap->driver, "Samsung FIMC Driver");
strcpy(cap->card, ctrl->vd->name, sizeof(cap->card));
sprintf(cap->bus_info, "FIMC AHB-bus");
cap->version = 0;
cap->capabilities = (V4L2_CAP_VIDEO_OVERLAY | \
                    V4L2_CAP_VIDEO_CAPTURE | V4L2_CAP_STREAMING);

return 0;
}

```

3) 应用层调用

```

static int video_capability(int fd)
{
    int ret = 0;
    /*****get the device capability*****/
    struct v4l2_capability cap;
    ret = ioctl(fd, VIDIOC_QUERYCAP, &cap);
    if (ret < 0) {
        perror("VIDIOC_QUERYCAP failed ");
        return ret;
    }

    printf("\n****Capability informations****\n");
    printf("driver:    %s\n", cap.driver);

    if (cap.capabilities & V4L2_CAP_VIDEO_CAPTURE)
        printf("Capture capability is supported\n");

    if (cap.capabilities & V4L2_CAP_STREAMING)
        printf("Streaming capability is supported\n");

    if (cap.capabilities & V4L2_CAP_VIDEO_OVERLAY)
        printf("Overlay capability is supported\n");

    return 0;
}

```

```

-----s3c_fimc_v4l2_querycap-----

****Capability informations****
driver:    Samsung FIMC Dris3c-fimc0
Capture capability is supported
Streaming capability is supported
Overlay capability is supported
select timeout

```

3.3 选择视频输入，一个视频设备可以有多个视频输入

1) 结构体

```
struct v4l2_input input;
```

```
int index;
```

```
得到 INPUT
```

```
ret = ioctl(fd, VIDIOC_G_INPUT, &index);
```

```
input.index = index;
```

```
列举 INPUT
```

```
ret = ioctl(fd, VIDIOC_ENUMINPUT, &input);
```

```
设置 INPUT
```

```
ret = ioctl(fd, VIDIOC_S_INPUT, &index);
```

```
struct v4l2_input {
    __u32      index;        /* Which input */
    __u8       name[32];     /* Label */
    __u32      type;         /* Type of input */
    __u32      audioset;     /* Associated audios (bitfield) */
    __u32      tuner;        /* Associated tuner */
    v4l2_std_id std;
    __u32      status;
    __u32      capabilities;
    __u32      reserved[3];
};
```

Ioctl: VIDIOC_S_INPUT

This IOCTL takes pointer to integer containing index of the input which has to be set. Application will provide the index number as an argument.

0 - Composite input,

1 - S-Video input.

2) 驱动

```
static int s3c_fimc_v4l2_s_input(struct file *filp, void *fh,
                                unsigned int i)
```

```
{
```

```
    struct s3c_fimc_control *ctrl = (struct s3c_fimc_control *) fh;
```

```
    if (i >= S3C_FIMC_MAX_INPUT_TYPES)
```

```
        return -EINVAL;
```

```
    ctrl->v4l2.input = &s3c_fimc_input_types[i];
```

```
    if (s3c_fimc_input_types[i].type == V4L2_INPUT_TYPE_CAMERA)
```

```
        ctrl->in_type = PATH_IN_ITU_CAMERA;
```

```
    else
```



```

        ctrl->in_type = PATH_IN_DMA;

    return 0;
}
static struct v4l2_input s3c_fimc_input_types[] = {
    {
        .index      = 0,
        .name        = "External Camera Input",
        .type        = V4L2_INPUT_TYPE_CAMERA,
        .audioset    = 1,
        .tuner        = 0,
        .std          = V4L2_STD_PAL_BG | V4L2_STD_NTSC_M,
        .status       = 0,
    },
    {
        .index      = 1,
        .name        = "Memory Input",
        .type        = V4L2_INPUT_TYPE_MEMORY,
        .audioset    = 2,
        .tuner        = 0,
        .std          = V4L2_STD_PAL_BG | V4L2_STD_NTSC_M,
        .status       = 0,
    }
};
static int s3c_fimc_v4l2_enum_input(struct file *filp, void *fh,
                                   struct v4l2_input *i)
{
    if (i->index >= S3C_FIMC_MAX_INPUT_TYPES)
        return -EINVAL;

    memcpy(i, &s3c_fimc_input_types[i->index], sizeof(struct v4l2_input));

    return 0;
}

```

3) 应用

```

static int video_input(int fd)
{
    /******get and set the VIDIO INPUT******/
    int ret = 0;
    struct v4l2_input input; //视频输入信息，对应命令 VIDIOC_ENUMINPUT
    int index;
    index = 0;    //0 - Composite input, 1 - S-Video input.

    ret = ioctl (fd, VIDIOC_S_INPUT, &index);
}

```

```

    if (ret < 0) {
        perror ("VIDIOC_S_INPUT");
        return ret;
    }

    input.index = index;
    ret = ioctl (fd, VIDIOC_ENUMINPUT, &input);
    if (ret < 0){
        perror ("VIDIOC_ENUMINPUT");
        return ret;
    }
    printf("\n***input informations***\n");
    printf("name of the input = %s\n", input.name);
    return 0;
}

```

3.4 遍历所有视频格式,查询驱动所支持的格式

1) 结构

```

struct v4l2_fmtdes fmdes;
ret = ioctl(fd, VIDIOC_ENUM_FMT, &fmdes);
struct v4l2_fmtdesc {
    __u32          index;           /* Format number      */
    enum v4l2_buf_type  type;       /* buffer type       */
    __u32          flags;
    __u8           description[32]; /* Description string */
    __u32          pixelformat;     /* Format fourcc      */
    __u32          reserved[4];
};

```

2) 驱动

```

static int s3c_fimc_v4l2_enum_fmt_vid_cap(struct file *filp, void *fh,
                                           struct v4l2_fmtdesc *f)
{
    struct s3c_fimc_control *ctrl = (struct s3c_fimc_control *) fh;
    int index = f->index;

    if (index >= S3C_FIMC_MAX_CAPTURE_FORMATS)
        return -EINVAL;

    memset(f, 0, sizeof(*f));
    memcpy(f, ctrl->v4l2_fmtdesc + index, sizeof(*f));

    return 0;
}

```

```
#define S3C_FIMC_MAX_CAPTURE_FORMATS ARRAY_SIZE(s3c_fimc_capture_formats)
```

```
const static struct v4l2_fmtdesc s3c_fimc_capture_formats[] = {
```

```
{
    .index      = 0,
    .type       = V4L2_BUF_TYPE_VIDEO_CAPTURE,
    .flags      = FORMAT_FLAGS_PLANAR,
    .description = "4:2:0, planar, Y-Cb-Cr",
    .pixelformat = V4L2_PIX_FMT_YUV420,
},
```

```
{
    .index      = 1,
    .type       = V4L2_BUF_TYPE_VIDEO_CAPTURE,
    .flags      = FORMAT_FLAGS_PLANAR,
    .description = "4:2:2, planar, Y-Cb-Cr",
    .pixelformat = V4L2_PIX_FMT_YUV422P,
```

```
},
{
    .index      = 2,
    .type       = V4L2_BUF_TYPE_VIDEO_CAPTURE,
    .flags      = FORMAT_FLAGS_PACKED,
    .description = "4:2:2, packed, YCBYCR",
    .pixelformat = V4L2_PIX_FMT_YUYV,
```

```
},
{
    .index      = 3,
    .type       = V4L2_BUF_TYPE_VIDEO_CAPTURE,
    .flags      = FORMAT_FLAGS_PACKED,
    .description = "4:2:2, packed, CBYCRY",
    .pixelformat = V4L2_PIX_FMT_UYVY,
```

```
};
```

```
const static struct v4l2_fmtdesc s3c_fimc_overlay_formats[] = {
```

```
{
    .index      = 0,
    .type       = V4L2_BUF_TYPE_VIDEO_OVERLAY,
    .flags      = FORMAT_FLAGS_PACKED,
    .description = "16 bpp RGB, le",
    .pixelformat = V4L2_PIX_FMT_RGB565,
```

```
},
{
    .index      = 1,
    .type       = V4L2_BUF_TYPE_VIDEO_OVERLAY,
    .flags      = FORMAT_FLAGS_PACKED,
```

```

        .description    = "24 bpp RGB, le",
        .pixelformat    = V4L2_PIX_FMT_RGB24,
    },
};

3) 应用层
static int video_fmtdesc(int fd)
{
    /*****Format Enumeration*****/
    int ret = 0;
    struct v4l2_fmtdesc fmdes;
    CLEAR(fmdes);
    fmdes.index = 0;
    fmdes.type = V4L2_BUF_TYPE_VIDEO_CAPTURE;
    printf("\n*****vidioc enumeration stream format informations:*****\n");
    while (1) {

        ret = ioctl(fd, VIDIOC_ENUM_FMT, &fmdes);
        if (ret < 0)
            break;

        printf("{ pixelformat = %c%c%c%c, description = %s }\n",
               (fmdes.pixelformat & 0xFF),
               (fmdes.pixelformat >> 8) & 0xFF,
               (fmdes.pixelformat >> 16) & 0xFF,
               (fmdes.pixelformat >> 24) & 0xFF,
               fmdes.description);

        if (fmdes.type == V4L2_BUF_TYPE_VIDEO_CAPTURE)
            printf("video capture type:\n");
        if (fmdes.pixelformat == V4L2_PIX_FMT_YUYV)
            printf("V4L2_PIX_FMT_YUYV\n");
        fmdes.index++;
    }
    return 0;
}

```

3.5 设置视频捕获格式（重要）

1) 结构体

帧格式包括宽度和高度

```
struct v4l2_format fmt;
```

```
ret = ioctl(fd, VIDIOC_S_FMT, &fmt);
```

```
struct v4l2_format {
```

```
    enum v4l2_buf_type type; //数据流类型，必须是 V4L2_BUF_TYPE_VIDEO_CAPTURE
```

```

union {
    struct v4l2_pix_format    pix;        /* V4L2_BUF_TYPE_VIDEO_CAPTURE */
    struct v4l2_window        win;        /* V4L2_BUF_TYPE_VIDEO_OVERLAY */
    struct v4l2_vbi_format     vbi;        /* V4L2_BUF_TYPE_VBI_CAPTURE */
    struct v4l2_sliced_vbi_format sliced;    /*
V4L2_BUF_TYPE_SLICED_VBI_CAPTURE */
    __u8    raw_data[200];                /* user-defined */
} fmt;
};

struct v4l2_pix_format {
    __u32 pixelformat; //视频数据存储类型，例如是 YUV4:2:2 还是 RGB
}

2)驱动
static int s3c_fimc_v4l2_s_fmt_vid_cap(struct file *filp, void *fh,
                                         struct v4l2_format *f)
{
    struct s3c_fimc_control *ctrl = (struct s3c_fimc_control *) fh;
    ctrl->v4l2.frmbuf.fmt = f->fmt.pix;

    if (f->fmt.pix.priv == V4L2_FMT_IN)
        s3c_fimc_set_input_frame(ctrl, &f->fmt.pix);
    else
        s3c_fimc_set_output_frame(ctrl, &f->fmt.pix);

    return 0;
}

int s3c_fimc_set_input_frame(struct s3c_fimc_control *ctrl,
                             struct v4l2_pix_format *fmt)
{
    s3c_fimc_set_input_format(ctrl, fmt);

    return 0;
}

static void s3c_fimc_set_input_format(struct s3c_fimc_control *ctrl,
                                       struct v4l2_pix_format *fmt)
{
    struct s3c_fimc_in_frame *frame = &ctrl->in_frame;

    frame->width = fmt->width;
    frame->height = fmt->height;

    switch (fmt->pixelformat) {

```

```
case V4L2_PIX_FMT_RGB565:
    frame->format = FORMAT_RGB565;
    frame->planes = 1;
    break;

case V4L2_PIX_FMT_RGB24:
    frame->format = FORMAT_RGB888;
    frame->planes = 1;
    break;

case V4L2_PIX_FMT_NV12:
    frame->format = FORMAT_YCBCR420;
    frame->planes = 2;
    frame->order_2p = LSB_CBCR;
    break;

case V4L2_PIX_FMT_NV21:
    frame->format = FORMAT_YCBCR420;
    frame->planes = 2;
    frame->order_2p = LSB_CRCB;
    break;

case V4L2_PIX_FMT_NV12X:
    frame->format = FORMAT_YCBCR420;
    frame->planes = 2;
    frame->order_2p = MSB_CBCR;
    break;

case V4L2_PIX_FMT_NV21X:
    frame->format = FORMAT_YCBCR420;
    frame->planes = 2;
    frame->order_2p = MSB_CRCB;
    break;

case V4L2_PIX_FMT_YUV420:
    frame->format = FORMAT_YCBCR420;
    frame->planes = 3;
    break;

case V4L2_PIX_FMT_YUYV:
    frame->format = FORMAT_YCBCR422;
    frame->planes = 1;
    frame->order_1p = IN_ORDER422_YCBYCR;
    break;
```

```

case V4L2_PIX_FMT_YVYU:
    frame->format = FORMAT_YCBCR422;
    frame->planes = 1;
    frame->order_1p = IN_ORDER422_YCRYCB;
    break;

case V4L2_PIX_FMT_UYVY:
    frame->format = FORMAT_YCBCR422;
    frame->planes = 1;
    frame->order_1p = IN_ORDER422_CBYCRY;
    break;

case V4L2_PIX_FMT_VYUY:
    frame->format = FORMAT_YCBCR422;
    frame->planes = 1;
    frame->order_1p = IN_ORDER422_CRYCBY;
    break;

case V4L2_PIX_FMT_NV16:
    frame->format = FORMAT_YCBCR422;
    frame->planes = 2;
    frame->order_1p = LSB_CBCR;
    break;

case V4L2_PIX_FMT_NV61:
    frame->format = FORMAT_YCBCR422;
    frame->planes = 2;
    frame->order_1p = LSB_CRCB;
    break;

case V4L2_PIX_FMT_NV16X:
    frame->format = FORMAT_YCBCR422;
    frame->planes = 2;
    frame->order_1p = MSB_CBCR;
    break;

case V4L2_PIX_FMT_NV61X:
    frame->format = FORMAT_YCBCR422;
    frame->planes = 2;
    frame->order_1p = MSB_CRCB;
    break;

case V4L2_PIX_FMT_YUV422P:

```

```

        frame->format = FORMAT_YCBCR422;
        frame->planes = 3;
        break;
    }
}
3)应用层
static int video_setfmt(int fd)
{
    /*******set Stream data format*****/
    int ret = 0;
    struct v4l2_format fmt;
    CLEAR(fmt);
    fmt.type          =    V4L2_BUF_TYPE_VIDEO_CAPTURE;
    fmt.fmt.pix.width  =    640;
    fmt.fmt.pix.height =    480;
    fmt.fmt.pix.pixelformat = V4L2_PIX_FMT_YUYV;//for PAL
    fmt.fmt.pix.field = V4L2_FIELD_INTERLACED;

    ret = ioctl(fd, VIDIOC_S_FMT, &fmt);
    if (ret < 0) {
        perror("VIDIOC_S_FMT");
        return ret;
    }

    return 0;
}

```

3.6 视频格式查询

在 v4l2 中，有两种查询视频格式的方法，一个是遍历所有视频格式的一个是查询出一种格式的

/*查询出一种格式*/

```
ret = ioctl(fd, VIDIOC_G_FMT, &fmt);
```

/*遍历所有视频格式,查询驱动所支持的格式*/

VIDIOC_ENUM_FMT

1)驱动

```
static int s3c_fimc_v4l2_g_fmt_vid_cap(struct file *filp, void *fh,
                                     struct v4l2_format *f)

```

```

{
    struct s3c_fimc_control *ctrl = (struct s3c_fimc_control *) fh;
    int size = sizeof(struct v4l2_pix_format);

    memset(&f->fmt.pix, 0, size);
    memcpy(&f->fmt.pix, &(ctrl->v4l2_frmbuf.fmt), size);
}

```



```

        return 0;
    }
2) 应用
static int video_getfmt(int fd)
{
    /*****get Stream data format*****/
    int ret= 0;
    struct v4l2_format fmt;
    CLEAR(fmt);
    fmt.type = V4L2_BUF_TYPE_VIDEO_CAPTURE;
    ret = ioctl(fd, VIDIOC_G_FMT, &fmt);
    if (ret < 0) {
        perror("VIDIOC_G_FMT");
        return ret;
    }
    printf("/n*****vidioc get stream format informations:****\n");
    if (fmt.fmt.pix.pixelformat == V4L2_PIX_FMT_YUYV)
        printf("8-bit YUYVV pixel format\n");
        printf("Size of the buffer = %d\n", fmt.fmt.pix.sizeimage);
        printf("Line offset = %d\n", fmt.fmt.pix.bytesperline);
    if (fmt.fmt.pix.field == V4L2_FIELD_INTERLACED)
        printf("Storate format is interlaced frame format\n");

    return 0;
}

```

3.7 向驱动申请帧缓冲，内存，一般不超过 5 个,帧缓冲管理

1) 结构体

```

struct v4l2_requestbuffers req;
ret = ioctl(fd, VIDIOC_REQBUFS, &req);
ret = ioctl(fd, VIDIOC_QUERYBUF, &buf);//读取缓存

```

```

struct v4l2_requestbuffers {
    __u32          count;
    enum v4l2_buf_type    type;
    enum v4l2_memory    memory;
    __u32          reserved[2];
};

```

```

struct v4l2_buffer {
    __u32          index;
    enum v4l2_buf_type    type;

```

```

__u32          bytesused;
__u32          flags;
enum v4l2_field field;
struct timeval  timestamp;
struct v4l2_timecode timecode;
__u32          sequence;

/* memory location */
enum v4l2_memory memory;
union {
    __u32          offset;
    unsigned long   userptr;
} m;
__u32          length;
__u32          input;
__u32          reserved;
};

```

使用 `VIDIOC_REQBUFS` 我们获取了 `req.count` 个缓存，下一步通过调用 `VIDIOC_QUERYBUF` 命令来获取这些缓存的地址，然后使用 `mmap` 函数转换成应用程序中的绝对地址，最后把这些缓存放入缓存队列。

The main steps that the application must perform for buffer allocation are:

1. Allocating Memory
2. Getting Physical Address
3. Mapping Kernel Space Address to User Space

2) 驱动支持

```

static int s3c_fimc_v4l2_reqbufs(struct file *filp, void *fh,
                                struct v4l2_requestbuffers *b)
{
    if (b->memory != V4L2_MEMORY_MMAP) {
        err("V4L2_MEMORY_MMAP is only supported\n");
        return -EINVAL;
    }

    /* control user input */
    if (b->count > 4)
        b->count = 4;
    else if (b->count < 1)
        b->count = 1;
}

```

```

        return 0;
    }
    static int s3c_fimc_v4l2_querybuf(struct file *filp, void *fh,
                                     struct v4l2_buffer *b)
    {
        struct s3c_fimc_control *ctrl = (struct s3c_fimc_control *) fh;

        if (b->type != V4L2_BUF_TYPE_VIDEO_OVERLAY && \
            b->type != V4L2_BUF_TYPE_VIDEO_CAPTURE)
            return -EINVAL;

        if (b->memory != V4L2_MEMORY_MMAP)
            return -EINVAL;

        b->length = ctrl->out_frame.buf_size;

        /*
         * NOTE: we use the m.offset as an index for multiple frames out.
         * Because all frames are not contiguous, we cannot use it as
         * original purpose.
         * The index value used to find out which frame user wants to mmap.
         */
        b->m.offset = b->index * PAGE_SIZE;

        return 0;
    }
    static int s3c_fimc_v4l2_qbuf(struct file *filp, void *fh,
                                  struct v4l2_buffer *b)

```

```

    {
        return 0;
    }

```

3) 应用层

```

static int video_mmap(int fd)
{
    /******step 1*****requestbuffers Allocating Memory *****/
    int ret = 0;
    struct v4l2_requestbuffers req;
    CLEAR(req);
    req.count = 4;
    req.type = V4L2_BUF_TYPE_VIDEO_CAPTURE;
    req.memory = V4L2_MEMORY_MMAP;

    ret = ioctl(fd, VIDIOC_REQBUFS, &req);
    if (ret < 0) {

```

```

        perror("VIDIOC_REQBUFS");
        return ret;
    }

    if (req.count < 2)
        printf("insufficient buffer memory\n");
        printf("Number of buffers allocated = %d\n", req.count);

    /*****step 2****Getting Physical Address *****/
    buffers = calloc(req.count, sizeof(*buffers));
    for (n_buffers = 0; n_buffers < req.count; ++n_buffers)
    {
        struct v4l2_buffer buf; //驱动中的一帧
        CLEAR(buf);
        buf.type = V4L2_BUF_TYPE_VIDEO_CAPTURE;
        buf.memory = V4L2_MEMORY_MMAP;
        buf.index = n_buffers;

        ret = ioctl(fd, VIDIOC_QUERYBUF, &buf);
        if (ret < 0) {
            perror("VIDIOC_QUERYBUF");
            return ret;
        }

        /*****step 3****Mapping Kernel Space Address to User Space*****/
        buffers[n_buffers].length = buf.length;
        buffers[n_buffers].start =
            mmap(NULL,
                buf.length,
                PROT_READ | PROT_WRITE,
                MAP_SHARED,
                fd,
                buf.m.offset);

        //if (MAP_FAILED == buffers[n_buffers].start)
        //perror("mmap failed \n");
    }

    /*****request buffers in queue*****/
    for (i = 0; i < n_buffers; ++i) {
        struct v4l2_buffer buf;
        CLEAR(buf);

        buf.type = V4L2_BUF_TYPE_VIDEO_CAPTURE;

```

```

        buf.memory = V4L2_MEMORY_MMAP;
        buf.index = i;

        ret = ioctl(fd, VIDIOC_QBUF, &buf); //申请的缓冲进入队列
        if (ret < 0) {
            perror("VIDIOC_QBUF");
            return ret;
        }
    }

    return 0;
}

```

3.8 开始捕捉图像数据(重要)

1) 结构体

```

enum v4l2_buf_type type; //开始捕捉图像数据
    type = V4L2_BUF_TYPE_VIDEO_CAPTURE;
    ret = ioctl(fd, VIDIOC_STREAMON, &type);

enum v4l2_buf_type {
    V4L2_BUF_TYPE_VIDEO_CAPTURE          = 1,
    V4L2_BUF_TYPE_VIDEO_OUTPUT           = 2,
    V4L2_BUF_TYPE_VIDEO_OVERLAY          = 3,
    V4L2_BUF_TYPE_VBI_CAPTURE            = 4,
    V4L2_BUF_TYPE_VBI_OUTPUT             = 5,
    V4L2_BUF_TYPE_SLICED_VBI_CAPTURE     = 6,
    V4L2_BUF_TYPE_SLICED_VBI_OUTPUT      = 7,
#ifdef 1
    /* Experimental */
    V4L2_BUF_TYPE_VIDEO_OUTPUT_OVERLAY = 8,
#endif
    V4L2_BUF_TYPE_PRIVATE                 = 0x80,
};

```

2) 驱动

```

static int s3c_fimc_v4l2_streamon(struct file *filp, void *fh,
                                enum v4l2_buf_type i)
{
    struct s3c_fimc_control *ctrl = (struct s3c_fimc_control *) fh;
    if (i != V4L2_BUF_TYPE_VIDEO_CAPTURE)
        return -EINVAL;
}

```

```

printk("s3c_fimc_v4l2_streamon is called\n");
if (ctrl->in_type != PATH_IN_DMA)
    s3c_fimc_init_camera(ctrl);

ctrl->out_frame.skip_frames = 0;
FSET_CAPTURE(ctrl);
FSET_IRQ_NORMAL(ctrl);
s3c_fimc_start_dma(ctrl);

return 0;
}

```

硬件控制寄存器的配置

3) 应用层

```

static int video_streamon(int fd)
{
    int ret = 0;

    /*****start stream on*****/

    enum v4l2_buf_type types;//开始捕捉图像数据
    types = V4L2_BUF_TYPE_VIDEO_CAPTURE;
    ret = ioctl(fd, VIDIOC_STREAMON, &types);
    if (ret < 0) {
        perror("VIDIOC_STREAMON");
        return ret;
    }

    return 0;
}

```