

## Design of Angle Detection System Based on MPU6050

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**Abstract.** This paper describes the method of using MPU6050 to detect the dip angle, and designs the hardware circuit. In order to make the detection angle more accurate, the Calman filter algorithm is used in the software programming, which can effectively remove the interference and make the measurement precision higher. In the test, the experimental platform is built, which can accurately measure the horizontal angle and vertical angle, this design can be used for the inclination detection of flight control. It has a practical value.

### Introduction

MPU6050 is a nine axis motion sensor with 3 axis gyroscopes and a 3 axis accelerometer. And an extensible digital motion processor DMP, IIC or SPI interface can be connected to other sensors, the output is a 9 axis signal.

Angle detection in industrial production and practice has a lot of applications, such as the detection of the object's horizontal angle or tilt angle, can make the balance car or four rotor aircraft, to detect the object's attitude, that is, the spatial angle. According to the angle, a certain control algorithm is adopted, and the PID algorithm is used to balance the object. Angle detection can also be used to detect the elderly fall, this year, with the development of society, China has gradually entered the aging, the elderly population continues to increase. Old people's motor function decline, so the detection of the fall of electronic products produced. The front end of the sensor is MPU6050.

### MPU6050 Introduction

The MPU6050 pin diagram is shown in figure 1. Figure VDD supply pin is supplied by 3.3V, CS is a chip select signal. Data transfer using SPI or IIC interface. Figure 2 is a three-dimensional view of MPU6050 for angle detection.

MPU6050 has three 16 bit ADC respectively, to collect the acceleration value of the 3 axis or gyro value, which is converted to digital output. The range of gyroscopes measurement is plus or minus 250 degrees, plus or minus 500 degrees, plus or minus 1000 degrees, plus or minus 2000 degrees, the accelerometer measurement range is + 2G, + 4G, + 8g, + 16g. on chip 1MB FIFO, can be used for data cache. The serial communication interface, IIC rate can reach 400K, SPI rate is up to 1M., digital motion inside the DMP gyroscope SPI interface can reduce the complexity of the data fusion, the accurate output value of the angle.

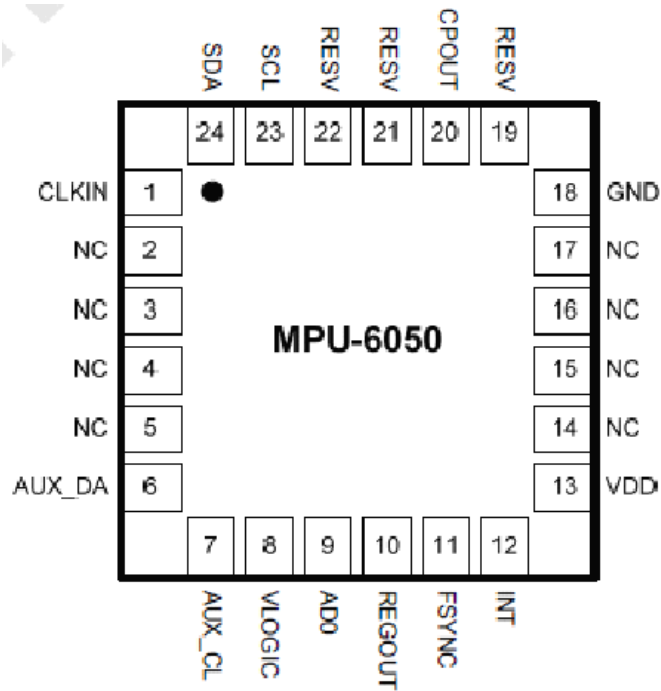


Figure 1 MPU6050 Pins

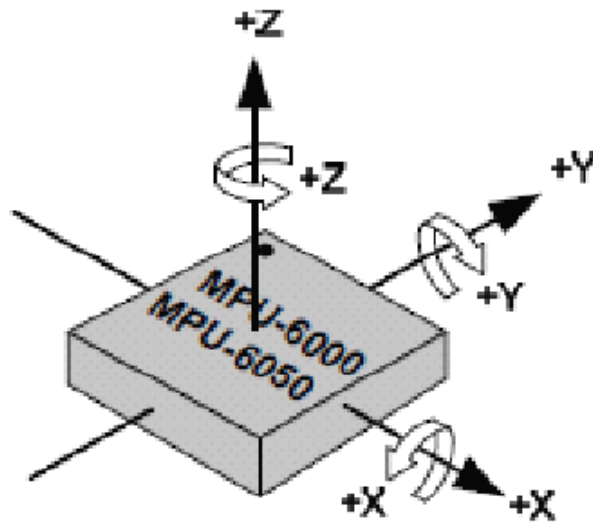


Figure 2 Three axis test chart

**Software Program**

In this design, in KEIL 5 under the C programming language. Complete the initialization of the MPU6050, and then call the DMP function output corresponding angle. The following part of the code:

```
void DMP_Init(void)
{
    u8 temp[1]={0};
    MPU6050_i2cRead(0x68,0x75,1,temp);
    printf("\r\nmpu_init");
    if(temp[0]!=0x68)NVIC_SystemReset();
    if(!mpu_init())
    {
```

```

if(!mpu_set_sensors(INV_XYZ_GYRO | INV_XYZ_ACCEL))
    printf("mpu_set_sensor\r\n");
if(!mpu_configure_fifo(INV_XYZ_GYRO | INV_XYZ_ACCEL))
    printf("mpu_configure\r\n");
if(!mpu_set_sample_rate(DEFAULT_MPU_HZ))
    printf("mpu_set_sample_rate\r\n");
if(!dmp_load_motion_driver_firmware())
    printf("dmp_load_motion\r\n");
if(!dmp_set_orientation(inv_orientation_matrix_to_scalar(gyro_orientation)))
    printf("dmp_set_orientation\r\n");
if(!dmp_enable_feature(DMP_FEATURE_6X_LP_QUAT | DMP_FEATURE_TAP |
    DMP_FEATURE_ANDROID_ORIENT | DMP_FEATURE_SEND_RAW_ACCEL
| DMP_FEATURE_SEND_CAL_GYRO | DMP_FEATURE_GYRO_CAL))
    printf("dmp_enable_feature\r\n");
if(!dmp_set_fifo_rate(DEFAULT_MPU_HZ))
    printf("dmp_set_fifo_rate \r\n");
run_self_test();
if(!mpu_set_dmp_state(1))
    printf("mpu_set_dmp_state\r\n");
}
}
void MPU6050_initialize(void) {
    MPU6050_setClockSource(MPU6050_CLOCK_PLL_YGYRO);
    MPU6050_setFullScaleGyroRange(MPU6050_GYRO_FS_2000);
    MPU6050_setFullScaleAccelRange(MPU6050_ACCEL_FS_2);
    MPU6050_setSleepEnabled(0);
    MPU6050_setI2CMasterModeEnabled(0);
    MPU6050_setI2CBypassEnabled(0);
    MPU6050_setI2CBypassEnabled(0);
}

```

The above code DMP\_Init () mainly to achieve the initialization of DMP, MPU6050\_initialize () to achieve the initialization of the MPU6050, set the measurement range.

### **Summary**

In this paper, the principle of using MPU6050 to detect the inclination is described. The hardware circuit is designed and the software is programmed. In the program, the MPU6050 is initialized, and the DMP method is used to detect the inclination angle, which reduces the data fusion and the interference. The test results show that the design can accurately detect the angle of moving objects, and has a certain practical value.

### **Reference**

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