Instalar Modulo Giroscopio Acelerómetro MPU-6050

Caracteristicas:

Usa el Circuito Integrado MPU-6050

Voltaje de Operación entre 3-5Vdc

Tipo de comunicación i2C

Internamente funciona como un convertidor Análogo a Digital con Salida de operación a 16 bit.

El rango del giroscopio es +250 500 1000 2000 Grados/s

El rango de aceleracion es ±2 ±4 ±8 ±16 g

Dimensiones aproximadas 21*15*1.2mm

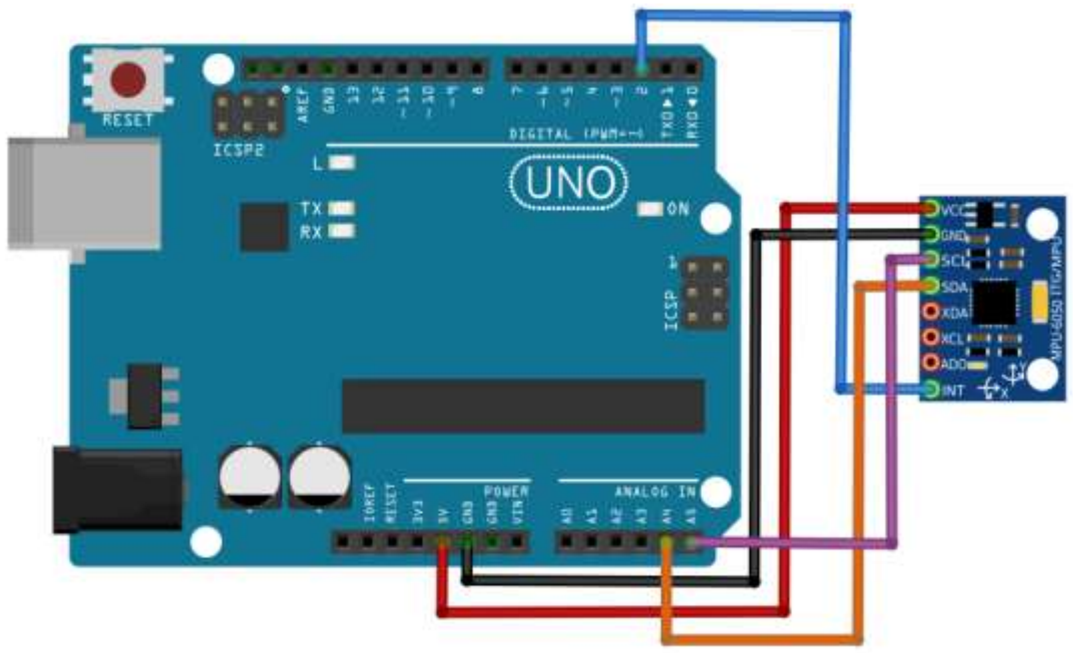
Peso Aproximado de 3gr

Materiales necesarios:

- Uno R3 + Cable USB para Arduino
- Modulo Giroscopio Acelerometro MPU-6050
- Varios Jumpers

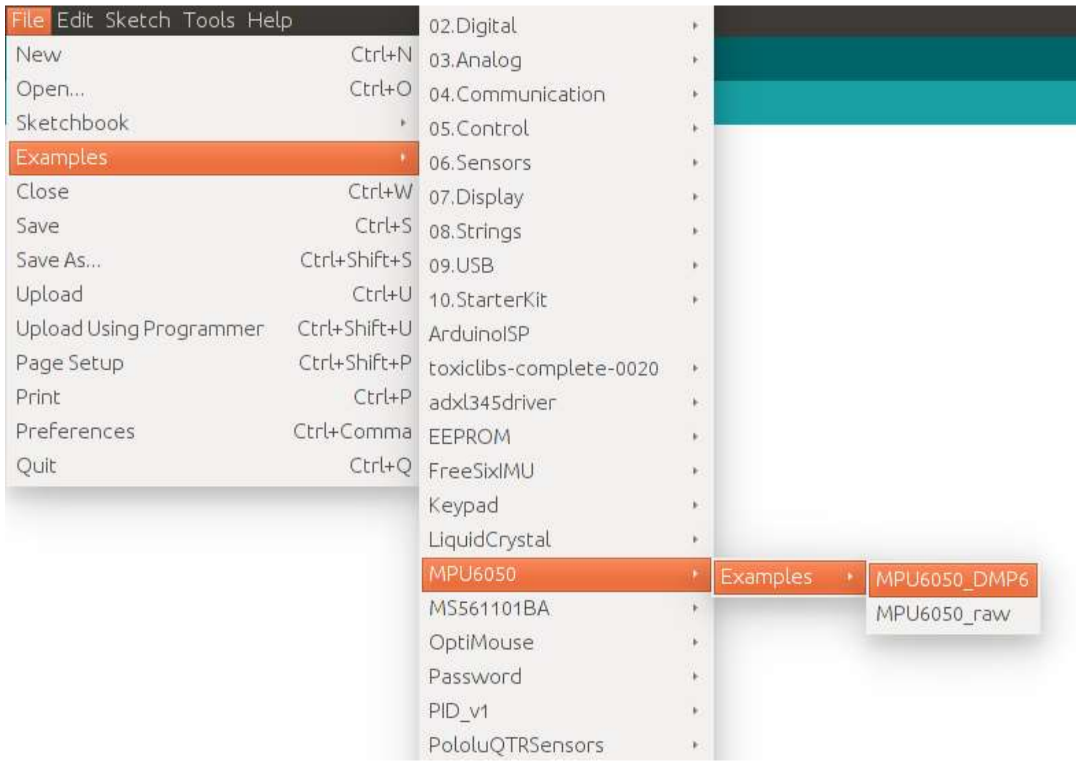
El Giroscopio MPU-6050 se comunica con el Arduino a través del protocolo I2C. El MPU-6050 está conectado a Arduino como se muestra en el siguiente diagrama. Aquí, debe de conectar su módulo MPU-6050 al pin de VCC 5Vdc de su Arduino. A continuación, el GND del Arduino está conectado al GND del MPU-6050. tambien se debe conectar la parte de data SDA al pin A4 y SCL al pin A5 y en el caso del grafico el pin INT a pin Digital 2.

Gráfico de Conexión:



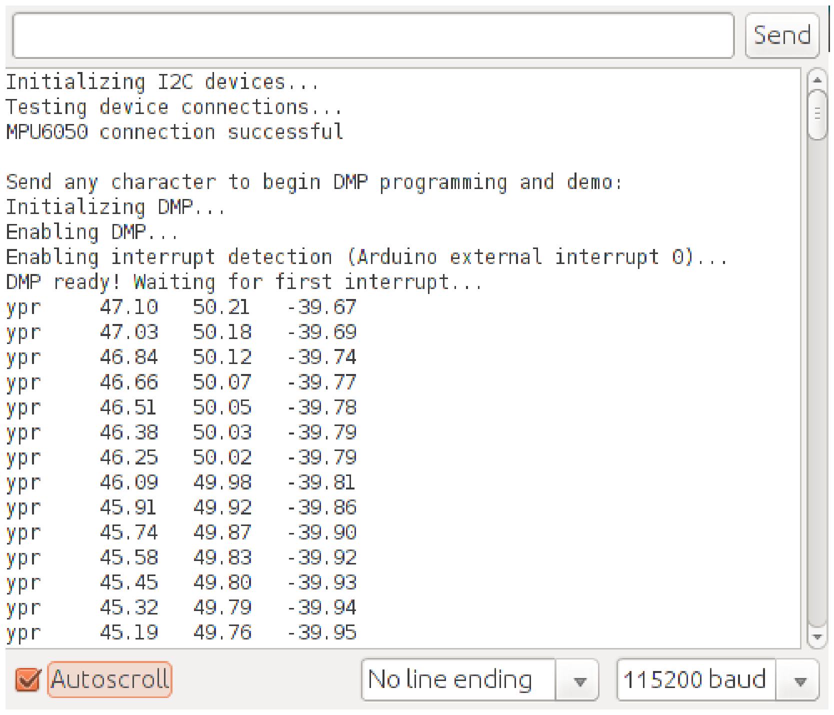
Para probar Arduino con MPU-6050, primero debemos descargar la libreria Arduino para MPU-6050, desarrollada por Jeff Rowberg. Luego, ir a la ubicación donde ha instalado arduino. Debes descomprimir la libreria en el folder de las librerias de arduino, la nombras "MPU6050". También podría tener que hacer lo mismo para instalar la libreria I2Cdev así, si no lo tiene para su arduino. Realizar el mismo procedimiento que el anterior para la instalación. puede descargar el archivo aquí: Si usted ha hecho esto correctamente, entonces cuando se abre el IDE Arduino, se puede ver "MPU6050" Ejemplos. A continuación, abra el programa de ejemplo de:

Archivo -> Ejemplos -> MPU6050 -> Ejemplos -> MPU6050_DMP6.



Cargar el codigo al Arduino. abra el monitor del puerto serie y ponga la velocidad de transmisión en 115200. A continuación, compruebe si ves el texto "Inicializar dispositivos I2C ..." en el monitor serial.

Si todo esta bien conectado y no lo hace, pulsar el botón de reinicio. Ahora, verá una línea que dice "Enviar cualquier caracter para comenzar la programación y demostración DMP:". Así que sólo tienes que escribir en cualquier carácter en el monitor serie y enviar. se comenzará a ver los valores de posicionamiento y balanceo que vienen de la MPU-6050. Al igual que:



```
Initializing I2C devices...
Testing device connections...
MPU6050 connection successful

Send any character to begin DMP programming and demo:
Initializing DMP...
Enabling DMP...
Enabling interrupt detection (Arduino external interrupt 0)...
DMP ready! Waiting for first interrupt...
ypr     47.10   50.21   -39.67
ypr     47.03   50.18   -39.69
ypr     46.84   50.12   -39.74
ypr     46.66   50.07   -39.77
ypr     46.51   50.05   -39.78
ypr     46.38   50.03   -39.79
ypr     46.25   50.02   -39.79
ypr     46.09   49.98   -39.81
ypr     45.91   49.92   -39.86
ypr     45.74   49.87   -39.90
ypr     45.58   49.83   -39.92
ypr     45.45   49.80   -39.93
ypr     45.32   49.79   -39.94
ypr     45.19   49.76   -39.95
```

Hay que esperar aproximadamente unos 10 segundos antes de llegar a los valores exactos generados por el MPU-6050. Después de lo cual, los valores comenzarán a estabilizarse.

Código:

```
// I2C device class (I2Cdev) demonstration Arduino sketch for MPU6050 class using DMP
(MotionApps v2.0)

// 6/21/2012 by Jeff Rowberg <jeff@rowberg.net>

// Updates should (hopefully) always be available at https://github.com/jrowberg/i2cdevlib

//

// Changelog:

//      2013-05-08 - added seamless Fastwire support

//                 - added note about gyro calibration

//      2012-06-21 - added note about Arduino 1.0.1 + Leonardo compatibility error

//      2012-06-20 - improved FIFO overflow handling and simplified read process

//      2012-06-19 - completely rearranged DMP initialization code and simplification

//      2012-06-13 - pull gyro and accel data from FIFO packet instead of reading directly

//      2012-06-09 - fix broken FIFO read sequence and change interrupt detection to RISING

//      2012-06-05 - add gravity-compensated initial reference frame acceleration output

//                 - add 3D math helper file to DMP6 example sketch

//                 - add Euler output and Yaw/Pitch/Roll output formats

//      2012-06-04 - remove accel offset clearing for better results (thanks Sungon Lee)

//      2012-06-01 - fixed gyro sensitivity to be 2000 deg/sec instead of 250

//      2012-05-30 - basic DMP initialization working


/* ============================================

I2Cdev device library code is placed under the MIT license

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```

```
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===============================================
*/

// I2Cdev and MPU6050 must be installed as libraries, or else the .cpp/.h files
// for both classes must be in the include path of your project
#include "I2Cdev.h"

#include "MPU6050_6Axis_MotionApps20.h"
//#include "MPU6050.h" // not necessary if using MotionApps include file

// Arduino Wire library is required if I2Cdev I2CDEV_ARDUINO_WIRE implementation
// is used in I2Cdev.h
#if I2CDEV_IMPLEMENTATION == I2CDEV_ARDUINO_WIRE
    #include "Wire.h"
#endif

// class default I2C address is 0x68
// specific I2C addresses may be passed as a parameter here
// AD0 low = 0x68 (default for SparkFun breakout and InvenSense evaluation board)
// AD0 high = 0x69
MPU6050 mpu;
//MPU6050 mpu(0x69); // <-- use for AD0 high

/* =========================================================================
   NOTE: In addition to connection 3.3v, GND, SDA, and SCL, this sketch
   depends on the MPU-6050's INT pin being connected to the Arduino's
   external interrupt #0 pin. On the Arduino Uno and Mega 2560, this is
   digital I/O pin 2.
 * ========================================================================= */

/* =========================================================================
  NOTE: Arduino v1.0.1 with the Leonardo board generates a compile error
  when using Serial.write(buf, len). The Teapot output uses this method.
  The solution requires a modification to the Arduino USBAPI.h file, which
  is fortunately simple, but annoying. This will be fixed in the next IDE
  release. For more info, see these links:

  http://arduino.cc/forum/index.php/topic,109987.0.html
  http://code.google.com/p/arduino/issues/detail?id=958
 * ========================================================================= */



// uncomment "OUTPUT_READABLE_QUATERNION" if you want to see the actual
// quaternion components in a [w, x, y, z] format (not best for parsing
// on a remote host such as Processing or something though)
//#define OUTPUT_READABLE_QUATERNION

// uncomment "OUTPUT_READABLE_EULER" if you want to see Euler angles
// (in degrees) calculated from the quaternions coming from the FIFO.
// Note that Euler angles suffer from gimbal lock (for more info, see
// http://en.wikipedia.org/wiki/Gimbal_lock)
//#define OUTPUT_READABLE_EULER

// uncomment "OUTPUT_READABLE_YAWPITCHROLL" if you want to see the yaw/
// pitch/roll angles (in degrees) calculated from the quaternions coming
// from the FIFO. Note this also requires gravity vector calculations.
// Also note that yaw/pitch/roll angles suffer from gimbal lock (for
// more info, see: http://en.wikipedia.org/wiki/Gimbal_lock)
#define OUTPUT_READABLE_YAWPITCHROLL

// uncomment "OUTPUT_READABLE_REALACCEL" if you want to see acceleration
// components with gravity removed. This acceleration reference frame is
// not compensated for orientation, so +X is always +X according to the
// sensor, just without the effects of gravity. If you want acceleration
// compensated for orientation, us OUTPUT_READABLE_WORLDACCEL instead.
//#define OUTPUT_READABLE_REALACCEL

// uncomment "OUTPUT_READABLE_WORLDACCEL" if you want to see acceleration
// components with gravity removed and adjusted for the world frame of
// reference (yaw is relative to initial orientation, since no magnetometer
// is present in this case). Could be quite handy in some cases.
//#define OUTPUT_READABLE_WORLDACCEL

// uncomment "OUTPUT_TEAPOT" if you want output that matches the
// format used for the InvenSense teapot demo
//#define OUTPUT_TEAPOT




#define LED_PIN 13 // (Arduino is 13, Teensy is 11, Teensy++ is 6)
bool blinkState = false;

// MPU control/status vars
bool dmpReady = false;  // set true if DMP init was successful
uint8_t mpuIntStatus;   // holds actual interrupt status byte from MPU
uint8_t devStatus;      // return status after each device operation (0 = success, !0 = error)
uint16_t packetSize;    // expected DMP packet size (default is 42 bytes)
uint16_t fifoCount;     // count of all bytes currently in FIFO
uint8_t fifoBuffer[64]; // FIFO storage buffer

// orientation/motion vars
Quaternion q;           // [w, x, y, z]         quaternion container
VectorInt16 aa;         // [x, y, z]            accel sensor measurements
VectorInt16 aaReal;     // [x, y, z]            gravity-free accel sensor measurements
VectorInt16 aaWorld;    // [x, y, z]            world-frame accel sensor measurements
VectorFloat gravity;    // [x, y, z]            gravity vector
float euler[3];         // [psi, theta, phi]    Euler angle container
float ypr[3];           // [yaw, pitch, roll]   yaw/pitch/roll container and gravity vector

// packet structure for InvenSense teapot demo
uint8_t teapotPacket[14] = { '$', 0x02, 0,0, 0,0, 0,0, 0,0, 0x00, 0x00, '\r', '\n' };




// ================================================================
// ===               INTERRUPT DETECTION ROUTINE                ===
// ================================================================

volatile bool mpuInterrupt = false;     // indicates whether MPU interrupt pin has gone high
void dmpDataReady() {
    mpuInterrupt = true;
}




// ================================================================
// ===                      INITIAL SETUP                       ===
// ================================================================

void setup() {
    // join I2C bus (I2Cdev library doesn't do this automatically)
    #if I2CDEV_IMPLEMENTATION == I2CDEV_ARDUINO_WIRE
        Wire.begin();
        TWBR = 24; // 400kHz I2C clock (200kHz if CPU is 8MHz)
    #elif I2CDEV_IMPLEMENTATION == I2CDEV_BUILTIN_FASTWIRE
        Fastwire::setup(400, true);
    #endif

    // initialize serial communication
    // (115200 chosen because it is required for Teapot Demo output, but it's
    // really up to you depending on your project)
    Serial.begin(115200);
    while (!Serial); // wait for Leonardo enumeration, others continue immediately

    // NOTE: 8MHz or slower host processors, like the Teensy @ 3.3v or Ardunio
    // Pro Mini running at 3.3v, cannot handle this baud rate reliably due to
    // the baud timing being too misaligned with processor ticks. You must use
    // 38400 or slower in these cases, or use some kind of external separate
    // crystal solution for the UART timer.

    // initialize device
    Serial.println(F("Initializing I2C devices..."));
    mpu.initialize();
    // verify connection
    Serial.println(F("Testing device connections..."));
    Serial.println(mpu.testConnection() ? F("MPU6050 connection successful") : F("MPU6050
connection failed"));

    // wait for ready
    Serial.println(F("\nSend any character to begin DMP programming and demo: "));
    while (Serial.available() && Serial.read()); // empty buffer
    while (!Serial.available());                 // wait for data
    while (Serial.available() && Serial.read()); // empty buffer again

    // load and configure the DMP
    Serial.println(F("Initializing DMP..."));
    devStatus = mpu.dmpInitialize();

    // supply your own gyro offsets here, scaled for min sensitivity
    mpu.setXGyroOffset(220);
    mpu.setYGyroOffset(76);
    mpu.setZGyroOffset(-85);
    mpu.setZAccelOffset(1788); // 1688 factory default for my test chip

    // make sure it worked (returns 0 if so)
    if (devStatus == 0) {
        // turn on the DMP, now that it's ready
        Serial.println(F("Enabling DMP..."));
        mpu.setDMPEnabled(true);

        // enable Arduino interrupt detection
        Serial.println(F("Enabling interrupt detection (Arduino external interrupt 0)..."));
        attachInterrupt(0, dmpDataReady, RISING);
        mpuIntStatus = mpu.getIntStatus();

        // set our DMP Ready flag so the main loop() function knows it's okay to use it
        Serial.println(F("DMP ready! Waiting for first interrupt..."));
        dmpReady = true;

        // get expected DMP packet size for later comparison
        packetSize = mpu.dmpGetFIFOPacketSize();
    } else {
        // ERROR!
        // 1 = initial memory load failed
        // 2 = DMP configuration updates failed
        // (if it's going to break, usually the code will be 1)
        Serial.print(F("DMP Initialization failed (code "));
        Serial.print(devStatus);
        Serial.println(F(")"));
    }

    // configure LED for output
    pinMode(LED_PIN, OUTPUT);
}



// ================================================================
// ===                      MAIN PROGRAM LOOP                   ===
// ================================================================

void loop() {
    // if programming failed, don't try to do anything
    if (!dmpReady) return;

    // wait for MPU interrupt or extra packet(s) available
    while (!mpuInterrupt && fifoCount < packetSize) {
        // other program behavior stuff here
        // .
        // .
        // .
        // if you are really paranoid you can frequently test in between other
        // stuff to see if mpuInterrupt is true, and if so, "break;" from the
        // while() loop to immediately process the MPU data
        // .
        // .
        // .
    }
```

```
// reset interrupt flag and get INT_STATUS byte
mpuInterrupt = false;
mpuIntStatus = mpu.getIntStatus();

// get current FIFO count
fifoCount = mpu.getFIFOCount();

// check for overflow (this should never happen unless our code is too inefficient)
if ((mpuIntStatus & 0x10) || fifoCount == 1024) {
  // reset so we can continue cleanly
  mpu.resetFIFO();
  Serial.println(F("FIFO overflow!"));

// otherwise, check for DMP data ready interrupt (this should happen frequently)
} else if (mpuIntStatus & 0x02) {
  // wait for correct available data length, should be a VERY short wait
  while (fifoCount < packetSize) fifoCount = mpu.getFIFOCount();


  // read a packet from FIFO
  mpu.getFIFOBytes(fifoBuffer, packetSize);


  // track FIFO count here in case there is > 1 packet available
  // (this lets us immediately read more without waiting for an interrupt)
  fifoCount -= packetSize;


  #ifdef OUTPUT_READABLE_QUATERNION
    // display quaternion values in easy matrix form: w x y z
    mpu.dmpGetQuaternion(&q, fifoBuffer);
    Serial.print("quat\t");
    Serial.print(q.w);
    Serial.print("\t");
    Serial.print(q.x);
    Serial.print("\t");
    Serial.print(q.y);
    Serial.print("\t");
    Serial.println(q.z);
  #endif
```

```
#ifdef OUTPUT_READABLE_EULER
  // display Euler angles in degrees
  mpu.dmpGetQuaternion(&q, fifoBuffer);
  mpu.dmpGetEuler(euler, &q);
  Serial.print("euler\t");
  Serial.print(euler[0] * 180/M_PI);
  Serial.print("\t");
  Serial.print(euler[1] * 180/M_PI);
  Serial.print("\t");
  Serial.println(euler[2] * 180/M_PI);
#endif

#ifdef OUTPUT_READABLE_YAWPITCHROLL
  // display Euler angles in degrees
  mpu.dmpGetQuaternion(&q, fifoBuffer);
  mpu.dmpGetGravity(&gravity, &q);
  mpu.dmpGetYawPitchRoll(ypr, &q, &gravity);
  Serial.print("ypr\t");
  Serial.print(ypr[0] * 180/M_PI);
  Serial.print("\t");
  Serial.print(ypr[1] * 180/M_PI);
  Serial.print("\t");
  Serial.println(ypr[2] * 180/M_PI);
#endif

#ifdef OUTPUT_READABLE_REALACCEL
  // display real acceleration, adjusted to remove gravity
  mpu.dmpGetQuaternion(&q, fifoBuffer);
  mpu.dmpGetAccel(&aa, fifoBuffer);
  mpu.dmpGetGravity(&gravity, &q);
  mpu.dmpGetLinearAccel(&aaReal, &aa, &gravity);
  Serial.print("areal\t");
  Serial.print(aaReal.x);
  Serial.print("\t");
  Serial.print(aaReal.y);
  Serial.print("\t");
  Serial.println(aaReal.z);
#endif
```

```
        #ifdef OUTPUT_READABLE_WORLDACCEL
            // display initial world-frame acceleration, adjusted to remove gravity
            // and rotated based on known orientation from quaternion
            mpu.dmpGetQuaternion(&q, fifoBuffer);
            mpu.dmpGetAccel(&aa, fifoBuffer);
            mpu.dmpGetGravity(&gravity, &q);
            mpu.dmpGetLinearAccel(&aaReal, &aa, &gravity);
            mpu.dmpGetLinearAccelInWorld(&aaWorld, &aaReal, &q);
            Serial.print("aworld\t");
            Serial.print(aaWorld.x);
            Serial.print("\t");
            Serial.print(aaWorld.y);
            Serial.print("\t");
            Serial.println(aaWorld.z);
        #endif

        #ifdef OUTPUT_TEAPOT
            // display quaternion values in InvenSense Teapot demo format:
            teapotPacket[2] = fifoBuffer[0];
            teapotPacket[3] = fifoBuffer[1];
            teapotPacket[4] = fifoBuffer[4];
            teapotPacket[5] = fifoBuffer[5];
            teapotPacket[6] = fifoBuffer[8];
            teapotPacket[7] = fifoBuffer[9];
            teapotPacket[8] = fifoBuffer[12];
            teapotPacket[9] = fifoBuffer[13];
            Serial.write(teapotPacket, 14);
            teapotPacket[11]++; // packetCount, loops at 0xFF on purpose
        #endif

        // blink LED to indicate activity
        blinkState = !blinkState;
        digitalWrite(LED_PIN, blinkState);
    }
}
```