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The Research on CC2530 Nodes Communicating with Each Other Based on Wireless

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Abstract

This work has completed the communication between the CC2530 coordinator and the child CC2530 nodes based on the Zigbee protocol. In this system, the object is detected by the CC2530 ultrasonic nodes. The distance is calculated and the message is formed. The message is sent to the coordinator by IIC bus which includes the control instruction. The coordinator receives the control information and will issue a command to control alcohol sensor to control the motor interface. The system can control the motor forward, backward and keep the DC motor still. The system can be widely used in agriculture and other fields.

Keywords: *CC2530, DC motor, ZigBee protocol*

1. Introduction

CC2530 is a RF transceiver adapt to the 2.4-GHz IEEE 802.15.4. The power consumption of CC2530 is low. The ZigBee technology is a set of communication technologies about the networking, security and application software based on IEEE 802.15.4 wireless standard. The ZigBee Alliance announced the first ZigBee Specification V1.0 on June 27, 2005 [1]. The standard defines the network layer, physical layer (PHY), standard MAC layer (MAC) and supports the application services.

2. The Design of the hardware

2.1 The data acquisition

The design of system uses the data acquisition module. It mainly refers to the ultrasonic sensor module. It decides the number of the square wave by the transmission control information from the P0.1 pin. The ultrasonic sensor has the transmitter and the receiver. The transmitter sends the square waves.

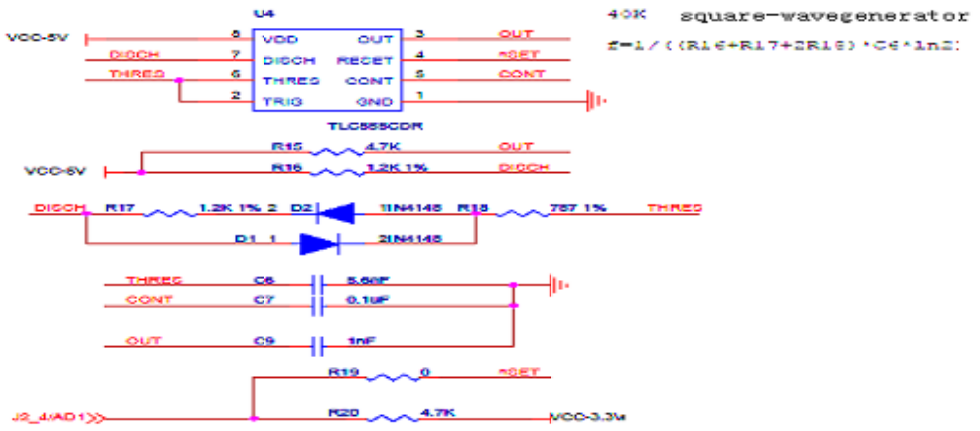

Figure 1. Principle Diagram

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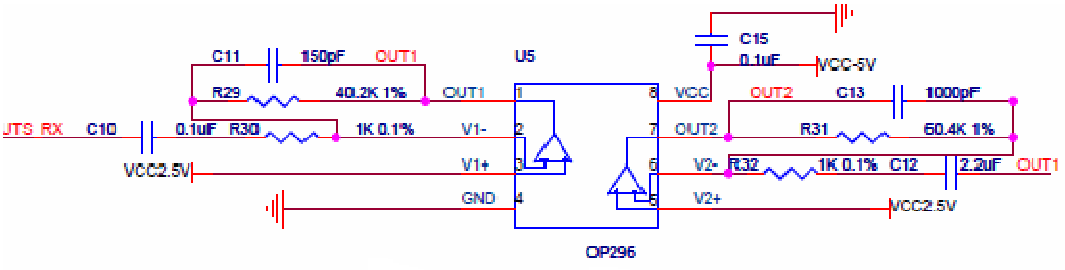

Figure 2. The schematic of the ultrasonic

The other port receives the reflected waves. After the voltage comparator, the P0.0 pin produces the interrupt. The analog data is converted into the digital data shown in the application layer through A/D transform. The schematic of the ultrasonic is as Figures 1 and 2.

When the ultrasonic sensors detect objects ahead, it will send the message which includes the command for the control of the alcohol on the coordinator in this system. When the distance tested by the ultrasonic sensor is longer than 20cm, a control message is transformed to the coordinator in the program.

2.2 Wireless Communication

Figure 3. The coordinator node Figure 4. The DC motor node Figure 5.The Ultrasonic Sensor

The hardware uses the device of the Beijing OURS Electronic Technology Co. LTD. The coordinator is the core of the system as shown in the Figure 3. The coordinator and the ultrasonic sensor use CC2530 as their main chip. Because it can apply the Zigbee protocol and RF4CE. Its largest transmit frequency is 4.5dbm. With the help of it, the system calls the IIC bus to send data packets or control signals when the ultrasonic sensor induces obstacles within the distance of 20cm. The coordinator receives the wireless control signals and sends the instruction to the alcohol sensor. Then the alcohol sensor executes the command and calls the DC motor modules by the interface which connects the alcohol with the DC motor [2]. The hardware running process of the system is shown as in the Figure 6.

3. The design and implementation of the system software

The work procedure of the software is as follows. First, the system needs to finish the initialization of all the wireless nodes' layers of the Zigbee protocol, such as Hal, Mac and so on. Second, the coordinator launches a self-organized Zigbee network [3]. And it will continue to monitor whether there are some nodes join or leave the network. The capacity of the network is a gateway, a coordinator, routers or other terminal nodes. Terminal nodes decide whether to join or leave the network. After their joining the Zigbee network, they accords to the system request of the coordinator to send their local information and the status signals, such as the distance of the ultrasonic sensor, the temperature, the humidity of the sensor, the optoelectronic, four red LED and so on. The sensor node updates the data once every 0.5 seconds. The data can change in accordance with environmental requirements.

The design of the CC2530 nodes can work independently [4]. The signals must be unified. But the nodes do not communicate with each other based on the ZigBee protocol

wireless networking. The coordinator needs to judge whether it should receive the relevant message [5]. Then it should know how to deal with all the kinds of information. So in the system, the corresponding processing information from the ultrasonic sensor node is also included in the system of the coordinator in the receiver processing function named zb_ Receive Data Indication. Of course, the corresponding processing information from the coordinator is also contained in the system of the ultrasonic sensor in the transmit processing function. The main section of the zb_ Receive Data Indication is displayed after the Figure 6.

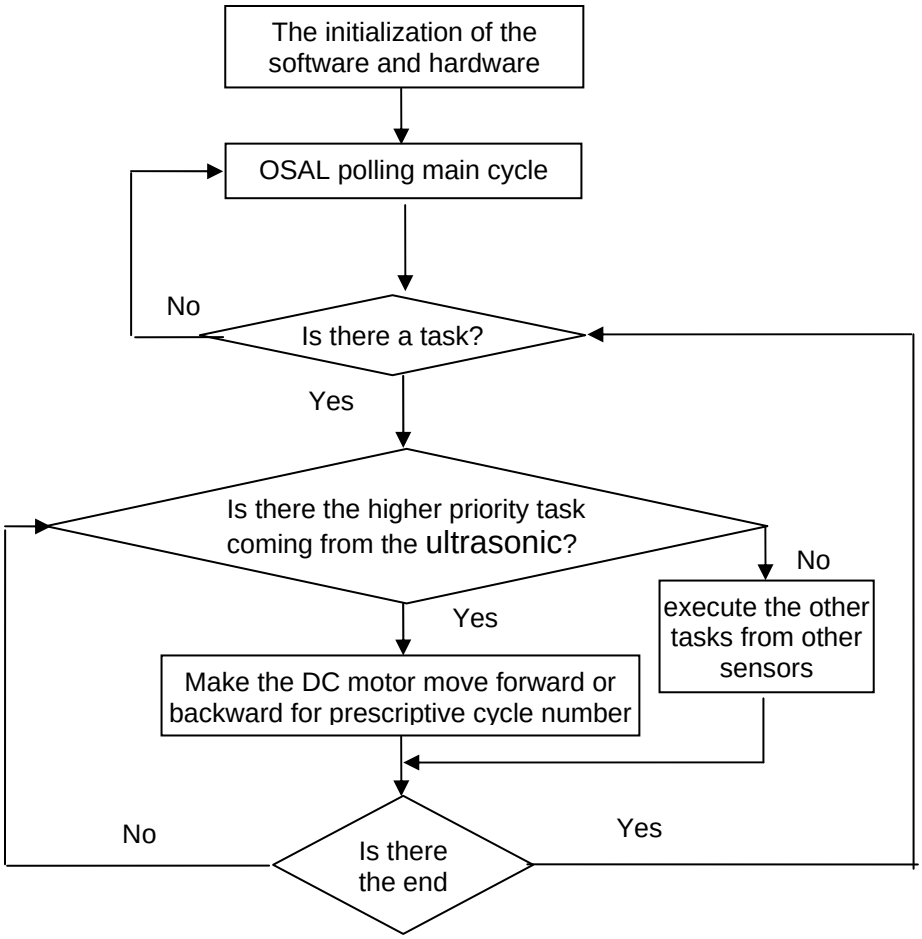

Figure 6. The flow chart of the system

The part program is as follows.

```
if (len == 22)
   {int m = 1;
       if (m)
       {
              ctrPCA9554Relay (2);
              ctrPCA9554_motor (0x01, 1);
              do {
              MicroWait (5000); / / Wait 5ms
              C + +;
               } While (c <100);
        m = 0;
       }
    if (m == 0)
      {
              ctrPCA9554Relay (1);
              ctrPCA9554_motor (0x01, 2);
              MicroWait (500); / / Wait 5ms
```

```
        }
    }
  else
    {
        ctrPCA9554Relay (1);
        ctrPCA9554_motor (0x01, 0);
    }
   if (len == * (pData +1))
   {
      * (PData +2) = LO_UINT16 (mywsnid);
      * (PData +3) = HI_UINT16 (mywsnid);
      * (PData + len-1) + = (HI_UINT16 (mywsnid) + LO_UINT16 (mywsnid));
      if (* (pData +4) == SENDUP_NODE_INFO)
      {
        * (PData +15) = rssi;
        * (PData +16) = lqi;
      }
      for (i = 0; i <(len-1); i + +)
      {
        num + = * (pData + i);
      }
      * (PData + len-1) = num;
   ……
```

4. Ultrasonic node module coding

The system achieves the hardware initialization of the ultrasonic node and signal acquisition [6]. The ultrasonic node takes charge of sending messages. The information acquisition function IICSensorControl achieves the process and the control of the collected information. Then it can call the function sendReport to send a message to the coordination module. Main parts of the code are as follows:

```
switch (Sensor ID)
{
  Case
    .........
  break;
  case resCode_Ultrasonic:
    uwavetime = Ultrasonic_start ();
      if ((uwavetime> 5) && (uwavetime <80))
     {
      * ADCdata = uwavetime * 17/10;
      osal_memcpy ((void *) & (SendUpSBoardDataPacket.data), ADCdata, 2);
      SendUpSBoardDataPacket.Len = 22;
      Sendflag = 1; sendReport ((uint8 *) (& SendUpSBoardDataPacket),
     SendUpSBoardDataPacket.Len);
      }
   break;
  default: break;
}
   .........
}
```

5. DC moving forward and backward

After the hardware power up, the coordinator starts to send the control message from the ultrasonic node to the expansion port of the the alcohol module. By it, the control message is transformed into the instruction which makes the DC motor rotate forward [7]. If the power provided by the coordinator is not enough, the port can control the other motor with the help of the relay. Because if the direction of the electric current of the motor module is positive, the instruction that makes the DC motor rotate inversely from the ultrasonic sensor can generate the current in negative direction. So when the current is in the positive direction, the relay is on. when the current is in the negative direction, the relay is off. When the relay is on, the other motor can work. Or else, it stops. Also it is a solution when the actual system needs the very large power.

The main code that can makes the DC motor forward or backward is as follows.

```
{
  uint8 output = 0x00;
  uint8 *data = 0;
```

```
if(ISendStr(0x48,0x03,&output,1))  //writng configuration
{
  if(motorID == 0x01)          //DC Motor
  {
    if(cmd == 0)              //stop
    {
      output = motor & 0xfc;
    }
    else if(cmd == 1)       //clockwise rotating
    {
      output = (motor & 0xfc) + 0x01;
    }
     else if(cmd == 2)     //anticlockwise rotating
    {
      output = (motor & 0xfc) + 0x02;
    }
   }
  else if(motorID == 0x02)
  {
    output = (motor & 0xc3) + cmd;
  }
   if(ISendStr(0x48,0x01,&output,1))
   {
     if(IRcvByte(0x48,data))
    {
       motor = *data;
       return *data;
    } }
  } return 0;
}
```

The PCA9554 in the section 3, 4 and 5 is the auxiliary chip which expands the I/O port of the main CC2530 chip. This can increase the ports of I/O.

6. Conclusion

This system overcomes many difficulties in the long-term practice to explore the many innovative points. In the original experiment, the realization of each function requires manual operation to complete. In this system, we successfully break through that. Through the software and hardware testing, the ultrasonic node can send wireless message which is received by the coordinator. Then the message makes the coordinator send the instruction that controls DC motor to move forward and backward automatically according to the ultrasonic sensor. This work discusses the work principle of three wireless nodes. And it explores the subsequent development by using the running characters of the hardware.

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