RĪGAS TEHNISKĀ UNIVERSITĀTE

ELEKTRONIKAS UN TELEKOMUNIKĀCIJU FAKULTĀTE

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Datu pārraide bezvadu sensoru tīklos

***Laboratorijas darbs Nr.3***

I REGV0

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Rīga, 2021

**Darba uzdevums:**

Laboratorijas darbā tiek modificēts kods no 2. laboratorijas darba, lai iekārta izsūtītu ziņu tikai tad, kad tiek nospiesta poga. Kods nosūta pogas nospiešanas reižu skaitu. Uztvērējs parāda ziņas saturu Termite programmā.

Izmantotā aparatūra: DISCO-L072CZ-LRWAN1 izstrādes platforma.

Izstrādātais c++ kods:

#include "mbed.h"

#include "PinMap.h"

#include "GenericPingPong.h"

#include "sx1276-mbed-hal.h"

#include "main.h"

#ifdef FEATURE\_LORA

/\* Set this flag to '1' to display debug messages on the console \*/

#define DEBUG\_MESSAGE 1

/\* Set this flag to '1' to use the LoRa modulation or to '0' to use FSK modulation \*/

#define USE\_MODEM\_LORA 0

#define USE\_MODEM\_FSK !USE\_MODEM\_LORA

#define RF\_FREQUENCY 868300000 // Hz

#define TX\_OUTPUT\_POWER 14 // 14 dBm

#if USE\_MODEM\_LORA == 1

#define LORA\_BANDWIDTH 125000 // LoRa default, details in SX1276::BandwidthMap

#define LORA\_SPREADING\_FACTOR LORA\_SF7

#define LORA\_CODINGRATE LORA\_ERROR\_CODING\_RATE\_4\_5

#define LORA\_PREAMBLE\_LENGTH 8 // Same for Tx and Rx

#define LORA\_SYMBOL\_TIMEOUT 5 // Symbols

#define LORA\_FIX\_LENGTH\_PAYLOAD\_ON false

#define LORA\_FHSS\_ENABLED false

#define LORA\_NB\_SYMB\_HOP 4

#define LORA\_IQ\_INVERSION\_ON false

#define LORA\_CRC\_ENABLED true

#elif USE\_MODEM\_FSK == 1

#define FSK\_FDEV 25000 // Hz H=1

#define FSK\_DATARATE 50000 // bps

#define FSK\_BANDWIDTH 100000 // Hz TX\_BW

#define FSK\_AFC\_BANDWIDTH 103473 // Hz RX\_BW

#define FSK\_PREAMBLE\_LENGTH 5 // Same for Tx and Rx

#define FSK\_FIX\_LENGTH\_PAYLOAD\_ON false

#define FSK\_CRC\_ENABLED true

#else

#error "Please define a modem in the compiler options."

#endif

#define RX\_TIMEOUT\_VALUE 0 // in ms

//#define BUFFER\_SIZE 32 // Define the payload size here

#define BUFFER\_SIZE 64 // Define the payload size here

/\*

\* Global variables declarations

\*/

typedef enum

{

IDLE,

RX\_COMPLETE,

RX\_TIMEOUT,

RX\_ERROR,

TX\_START,

TX\_WAITING\_COMPLETE,

TX\_COMPLETE,

TX\_TIMEOUT,

} AppStates\_t;

volatile AppStates\_t State = IDLE;

/\*!

\* Radio events function pointer

\*/

static RadioEvents\_t RadioEvents;

/\*

\* Global variables declarations

\*/

SX1276Generic \*Radio;

uint16\_t rxBufferSize; // Stoer las tRx message length in this global variable

uint8\_t rxBuffer[BUFFER\_SIZE+1];

uint16\_t txBufferSize;

uint8\_t txBuffer[BUFFER\_SIZE+1];

uint32\_t buttonPressCounter;

InterruptIn mybutton(USER\_BUTTON);

void myButtonInterruptFunction(){

if(State == IDLE){

State = TX\_START;

buttonPressCounter++;

}

}

int SX1276PingPong()

{

mybutton.fall(&myButtonInterruptFunction);

Radio = new SX1276Generic(NULL, MURATA\_SX1276,

LORA\_SPI\_MOSI, LORA\_SPI\_MISO, LORA\_SPI\_SCLK, LORA\_CS, LORA\_RESET,

LORA\_DIO0, LORA\_DIO1, LORA\_DIO2, LORA\_DIO3, LORA\_DIO4, LORA\_DIO5,

LORA\_ANT\_RX, LORA\_ANT\_TX, LORA\_ANT\_BOOST, LORA\_TCXO);

uint8\_t i;

dprintf("SX1276 Ping Pong Demo Application" );

dprintf("Freqency: %.6f", (double)RF\_FREQUENCY/1000000.0);

dprintf("TXPower: %d dBm", TX\_OUTPUT\_POWER);

#if USE\_MODEM\_LORA == 1

dprintf("Bandwidth: %d Hz", LORA\_BANDWIDTH);

dprintf("Spreading factor: SF%d", LORA\_SPREADING\_FACTOR);

#elif USE\_MODEM\_FSK == 1

dprintf("Bandwidth: %d kHz", FSK\_BANDWIDTH);

dprintf("Baudrate: %d", FSK\_DATARATE);

#endif

// Initialize Radio driver

RadioEvents.TxDone = OnTxDone;

RadioEvents.RxDone = OnRxDone;

RadioEvents.RxError = OnRxError;

RadioEvents.TxTimeout = OnTxTimeout;

RadioEvents.RxTimeout = OnRxTimeout;

if (Radio->Init( &RadioEvents ) == false) {

while(1) {

dprintf("Radio could not be detected!");

wait( 1 );

}

}

Radio->SetChannel(RF\_FREQUENCY );

#if USE\_MODEM\_LORA == 1

if (LORA\_FHSS\_ENABLED)

dprintf(" > LORA FHSS Mode <");

if (!LORA\_FHSS\_ENABLED)

dprintf(" > LORA Mode <");

Radio->SetTxConfig( MODEM\_LORA, TX\_OUTPUT\_POWER, 0, LORA\_BANDWIDTH,

LORA\_SPREADING\_FACTOR, LORA\_CODINGRATE,

LORA\_PREAMBLE\_LENGTH, LORA\_FIX\_LENGTH\_PAYLOAD\_ON,

LORA\_CRC\_ENABLED, LORA\_FHSS\_ENABLED, LORA\_NB\_SYMB\_HOP,

LORA\_IQ\_INVERSION\_ON, 2000 );

Radio->SetRxConfig( MODEM\_LORA, LORA\_BANDWIDTH, LORA\_SPREADING\_FACTOR,

LORA\_CODINGRATE, 0, LORA\_PREAMBLE\_LENGTH,

LORA\_SYMBOL\_TIMEOUT, LORA\_FIX\_LENGTH\_PAYLOAD\_ON, 0,

LORA\_CRC\_ENABLED, LORA\_FHSS\_ENABLED, LORA\_NB\_SYMB\_HOP,

LORA\_IQ\_INVERSION\_ON, true );

#elif USE\_MODEM\_FSK == 1

dprintf(" > FSK Mode <");

Radio->SetTxConfig( MODEM\_FSK, TX\_OUTPUT\_POWER, FSK\_FDEV, 0,

FSK\_DATARATE, 0,

FSK\_PREAMBLE\_LENGTH, FSK\_FIX\_LENGTH\_PAYLOAD\_ON,

FSK\_CRC\_ENABLED, 0, 0, 0, 2000 );

Radio->SetRxConfig( MODEM\_FSK, FSK\_BANDWIDTH, FSK\_DATARATE,

0, FSK\_AFC\_BANDWIDTH, FSK\_PREAMBLE\_LENGTH,

0, FSK\_FIX\_LENGTH\_PAYLOAD\_ON, 0, FSK\_CRC\_ENABLED,

0, 0, false, true );

#else

#error "Please define a modem in the compiler options."

#endif

dprintf("Wireless Sensor Networks LAB.3");

Radio->Rx( RX\_TIMEOUT\_VALUE );

while( 1 )

{

#ifdef TARGET\_STM32L4

WatchDogUpdate();

#endif

switch( State )

{

case IDLE:

// Do nothing - wait for button interrupt

sleep();

break;

case RX\_COMPLETE:

Radio->Rx( RX\_TIMEOUT\_VALUE ); // Put transceiver back to Rx

rxBuffer[rxBufferSize]=0; // For safety add Null Terminating character

dprintf("Rx complete, data is %s\n",rxBuffer);

State = IDLE;

break;

case RX\_TIMEOUT:

Radio->Rx( RX\_TIMEOUT\_VALUE ); // Put transceiver back to Rx

dprintf("Rx Timeout happened\n");

State = IDLE;

break;

case RX\_ERROR:

Radio->Rx( RX\_TIMEOUT\_VALUE ); // Put transceiver back to Rx

dprintf("Rx CRC Error happened\n");

State = IDLE;

break;

case TX\_START:

txBufferSize=sprintf((char\*)txBuffer, "Hello! buttonPressCounter=%d", buttonPressCounter);

txBufferSize++; // Add null terminated character to length

Radio->Sleep( ); // First we need to put chip from Rx to Sleep state

Radio->Send( txBuffer, txBufferSize );

dprintf("Message sent! buttonPressCounter was %d", buttonPressCounter);

State = TX\_WAITING\_COMPLETE;

break;

case TX\_WAITING\_COMPLETE:

sleep();

break;

case TX\_COMPLETE:

dprintf("Message sending complete!");

Radio->Rx( RX\_TIMEOUT\_VALUE ); // Put transceiver back to Rx

State = IDLE;

break;

case TX\_TIMEOUT:

dprintf("TX\_TIMEOUT happened!");

Radio->Rx( RX\_TIMEOUT\_VALUE ); // Put transceiver back to Rx

State = IDLE;

break;

default:

State = IDLE;

break;

}

}

}

void OnTxDone(void \*radio, void \*userThisPtr, void \*userData)

{

Radio->Sleep( );

State = TX\_COMPLETE;

if (DEBUG\_MESSAGE)

dprintf("> OnTxDone");

}

void OnRxDone(void \*radio, void \*userThisPtr, void \*userData, uint8\_t \*payload, uint16\_t size, int16\_t rssi, int8\_t snr)

{

Radio->Sleep( );

rxBufferSize = size;

memcpy( rxBuffer, payload, rxBufferSize );

State = RX\_COMPLETE;

if (DEBUG\_MESSAGE)

dprintf("> OnRxDone: RssiValue=%d dBm, SnrValue=%d", rssi, snr);

dump("Data:", payload, size);

}

void OnTxTimeout(void \*radio, void \*userThisPtr, void \*userData)

{

Radio->Sleep( );

State = TX\_TIMEOUT;

if(DEBUG\_MESSAGE)

dprintf("> OnTxTimeout");

}

void OnRxTimeout(void \*radio, void \*userThisPtr, void \*userData)

{

Radio->Sleep( );

State = RX\_TIMEOUT;

if (DEBUG\_MESSAGE)

dprintf("> OnRxTimeout");

}

void OnRxError(void \*radio, void \*userThisPtr, void \*userData)

{

Radio->Sleep( );

State = RX\_ERROR;

if (DEBUG\_MESSAGE)

dprintf("> OnRxError");

}

#endif

Rezultātā Termite terminālis parada sekojošas ziņas kad kods ir nokompilēts, ielādēts, un iekārtam ir nospiesta “reset” poga.

Graphical user interface, text, application

Description automatically generated

1. att. Ziņas no divām iekārtam

Graphical user interface, text, application

Description automatically generated

2. att. Ziņas no divām iekārtam kad tiek nospiesta poga 4 reizes uz vienas izstrādes plates

Graphical user interface, text, application, chat or text message

Description automatically generated

3. att. Ziņas no divām iekārtam kad tiek nospiesta poga 5 reizes uz otras izstrādes plates

**Secinājumi:**

Šajā darbā tika izveidots kods kas ļauj divām iekārtam izsūtīt ziņu tikai kad tiek nospiesta poga. Kods nosūta pogas nospiešanas reižu skaitu. Uztvērējs un raidītājs parāda ziņas saturu Termite programmā.