Ministry of Education, Culture and Research of the Republic of Moldova

Technical University of Moldova

Department of Software and Automatic Engineering

REPORT

Laboratory Project nr.6
at Embeded Systems

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Laboratory Project Nr.5

Topic: Comunicare

Objective: The objective of this laboratory work is to understand how transmit data between devices as kind of implemented protocol.

Domain: The Internet of Things (IoT), is based on the networking of things. In a nutshell, Internet of Things is defined as a “proposed development of the Internet in which everyday objects have network connectivity, allowing them to send and receive data.”

The most important thing here is connectivity among objects.

We can boil down the wireless communication protocols into the following 6 standards:

- Satellite
- WiFi
- Radio Frequency (RF)
- RFID
- Bluetooth
- NFC

Component description:

Electric lamp - An **electric lamp** is a conventional light emitting component used in different circuits, mainly for lighting and indicating purposes. The construction of lamp is quite simple, it has one filament surrounding which, a transparent glass made spherical cover is provided. The filament of the lamp is mainly made of tungsten as it has high melting point temperature. A lamp emits light energy as the thin small tungsten filament of lamp glows without being melted, while current flows through it.

Arduino Uno - The **Arduino Uno** is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc.[2][3] The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.[1] The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.[4] It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo.[5][6] The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available.

Liquid Crystal Display: A **liquid-crystal display** (**LCD**) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly,[1] instead using a backlight or reflector to produce images in color or monochrome.[2] LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made from a matrix of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement. For example, a character positive LCD with a backlight will have black lettering on a background that is the color of the backlight, and a character negative LCD will have a black background with the letters being of the same color as the backlight. Optical filters are added to white on blue LCDs to give them their characteristic appearance.

Implementation:

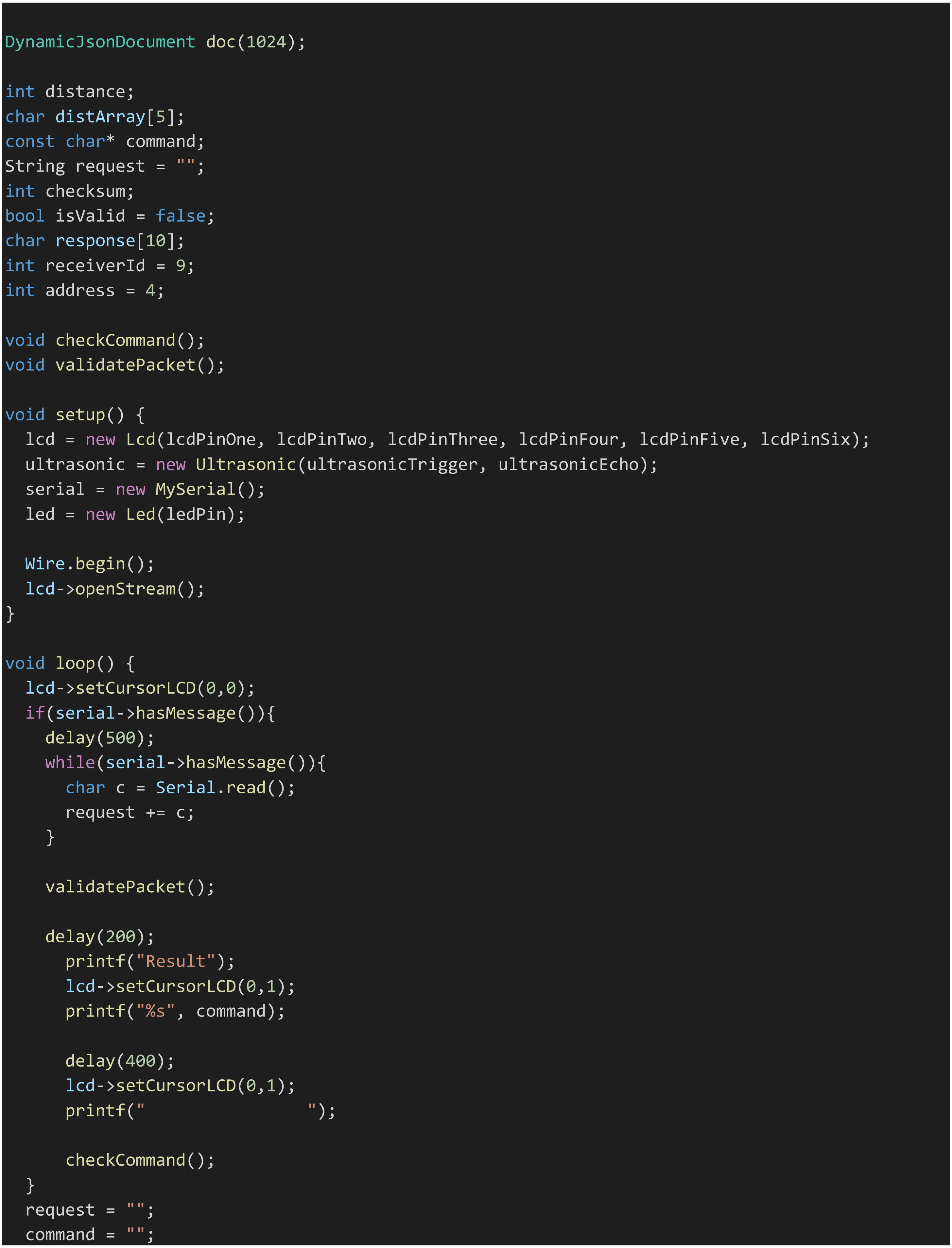
https://drive.google.com/open?id=1-6iEo9zzrN4-zUwgVG2uP-Ac914HL_ZN

Master:

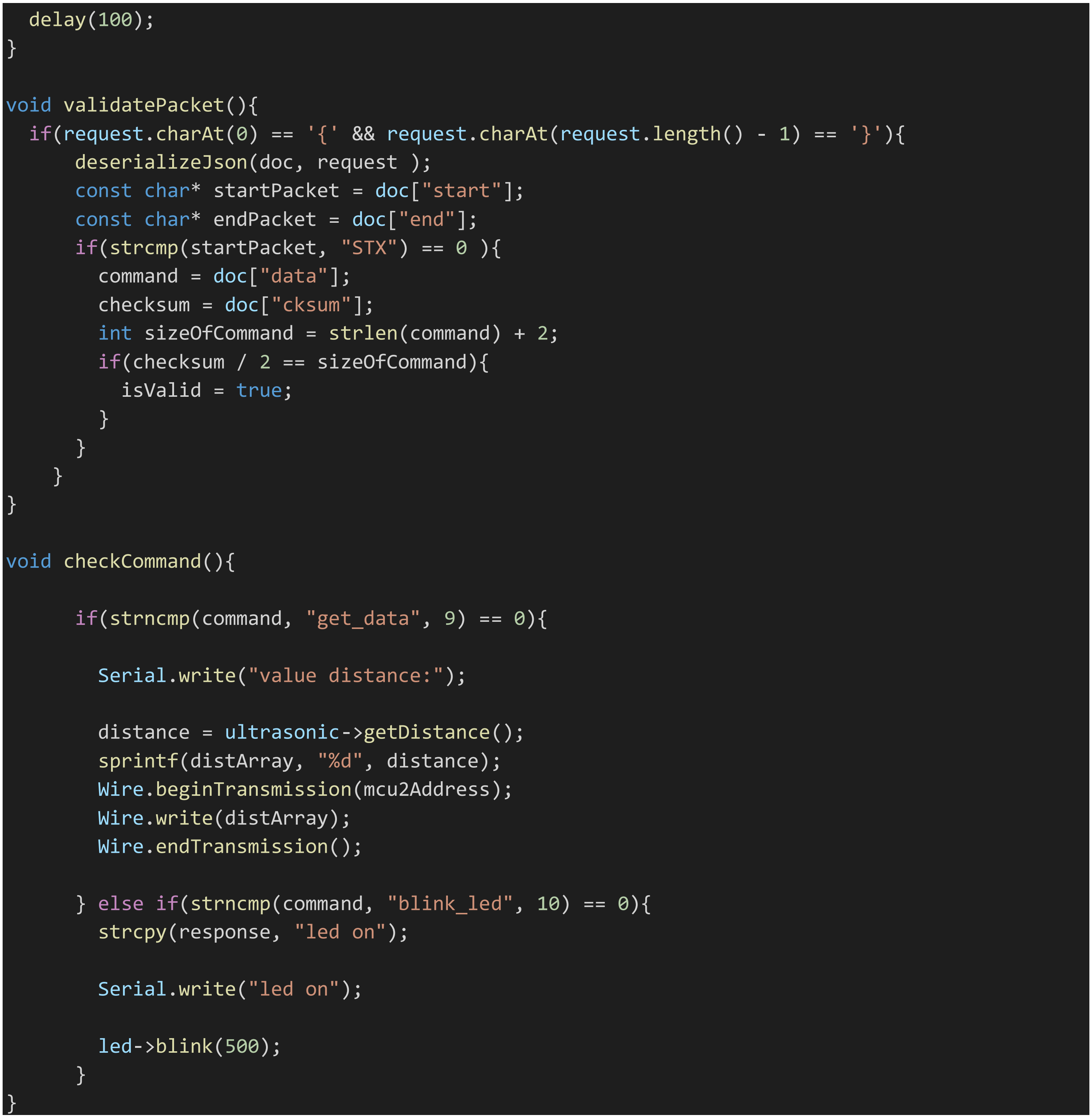
```
      #include "../include/Lab1/libs.h"
#include "../include/Lab1/conts.h"

Lcd *lcd;
MySerial *serial;
StaticJsonDocument<200> packet;

int distance;
char receive[5];
int nr = 1;
int receiverId = 4;
char command[10];
char request[100];
int x = 0;

void receiveEvent(int);

void setup() {
  lcd = new Lcd(lcdPinOne, lcdPinTwo, lcdPinThree, lcdPinFour, lcdPinFive, lcdPinSix);
  serial = new MySerial();

  Wire.begin(address);
  Wire.onReceive(receiveEvent);
  lcd->openStream();
}

void loop() {
  delay(500);

  if(x % 3 == 0){
    strcpy(command, "blink_led");
  } else {
    strcpy(command, "get_data");
  }
  int size = sizeof(command);
  int checksum = size * 2;

  packet["start"] = "STX";
  packet["pkID"] = nr++;
  packet["data"] = command;
  packet["cksum"] = checksum;
  serializeJson(packet, Serial);

  memset(command, 0, sizeof(command));

  delay(500);
  if(serial->hasMessage()){
    delay(100);
    int i = 0;
    while(serial->hasMessage()){
      char c = Serial.read();
      request[i] = c;
      i++;
    }
  }

  if(strncmp(request, "dist", 4) == 0){
  } else if (strcmp(request, "blink") == 0){
    lcd->setCursorLCD(0,0);
    printf("%s", request);
  }

  delay(200);
  memset(request, 0, sizeof(request));
  memset(receive, 0, sizeof(receive));
  x++;
  lcd->clearScreen();
}

void receiveEvent(int bytes){
  int i = 0;
  while(Wire.available()){
    receive[i] = Wire.read();
    i++;
  }
   lcd->setCursorLCD(0,0);
    printf("Result value:");
    lcd->setCursorLCD(0,1);
    printf("%s", receive);
}
```

Slave:

```
#include "../include/Lab1/libs.h"
#include "../include/Lab1/conts.h"

Lcd *lcd;
MySerial *serial;
Ultrasonic *ultrasonic;
Led *led;
```



```
DynamicJsonDocument doc(1024);

int distance;
char distArray[5];
const char* command;
String request = "";
int checksum;
bool isValid = false;
char response[10];
int receiverId = 9;
int address = 4;

void checkCommand();
void validatePacket();

void setup() {
  lcd = new Lcd(lcdPinOne, lcdPinTwo, lcdPinThree, lcdPinFour, lcdPinFive, lcdPinSix);
  ultrasonic = new Ultrasonic(ultrasonicTrigger, ultrasonicEcho);
  serial = new MySerial();
  led = new Led(ledPin);

  Wire.begin();
  lcd->openStream();
}

void loop() {
  lcd->setCursorLCD(0,0);
  if(serial->hasMessage()){
    delay(500);
    while(serial->hasMessage()){
      char c = Serial.read();
      request += c;
    }

    validatePacket();

    delay(200);
      printf("Result");
      lcd->setCursorLCD(0,1);
      printf("%s", command);

      delay(400);
      lcd->setCursorLCD(0,1);
      printf("                ");

      checkCommand();
  }
  request = "";
  command = "";
```



```
  delay(100);
}

void validatePacket(){
  if(request.charAt(0) == '{' && request.charAt(request.length() - 1) == '}'){
      deserializeJson(doc, request );
      const char* startPacket = doc["start"];
      const char* endPacket = doc["end"];
      if(strcmp(startPacket, "STX") == 0 ){
        command = doc["data"];
        checksum = doc["cksum"];
        int sizeOfCommand = strlen(command) + 2;
        if(checksum / 2 == sizeOfCommand){
          isValid = true;
        }
      }
    }
}

void checkCommand(){

      if(strncmp(command, "get_data", 9) == 0){

        Serial.write("value distance:");

        distance = ultrasonic->getDistance();
        sprintf(distArray, "%d", distance);
        Wire.beginTransmission(mcu2Address);
        Wire.write(distArray);
        Wire.endTransmission();

      } else if(strncmp(command, "blink_led", 10) == 0){
        strcpy(response, "led on");

        Serial.write("led on");

        led->blink(500);
      }
}
```

Conclusions: Working on this laboratory work am was implemented a communication between two Microcontrollers through I2C interface. I have understood how to connect two Arduino Uno devices in order to communicate between them. Data was transmitted using an implement specific protocol.