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	JIF = 1.500	SJIF (Morocco) = 2.031	

SOI: 1.1/TAS DOI: 10.15863/TAS

International Scientific Journal

Theoretical & Applied Science

p-ISSN: 2308-4944 (print) **e-ISSN:** 2409-0085 (online)

Year: 2016 **Issue:** 8 **Volume:** 40

Published: 30.08.2016 **http://T-Science.org**

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SECTION 2. Applied mathematics. Mathematical modeling.

ON SOME ALGORITHMS FOR PROGRAMMING ROBOTS

Abstract: *The article considers the problem of robot programming with the possibility of gas-chemical analysis of air for dangerous concentrations of combustible gases.*

Key words: *robot, programming, gas.*

Language: *English*

Citation: Shevtsov A (2016) ON SOME ALGORITHMS FOR PROGRAMMING ROBOTS. ISJ Theoretical & Applied Science, 08 (40): 79-86.

Soi: http://s-o-i.org/1.1/TAS-08-40-16 ***Doi***: http://dx.doi.org/10.15863/TAS.2016.08.40.16

Introduction

As a sample we consider a wheeled robot "Observer - chemical reconnaissance".

Brief description.

Small robot upravlenii remotely videonabljudenie and chemical analyzers air for the presence of high concentrations of hazardous and flammable gases.

Functionality:

- covert surveillance of the area
- remote control
- chemical analysis of air for dangerous concentrations of gases (propane, methane, n-butane, smoke, hydrogen, natural gas, petroleum gas, butane, carbon dioxide, carbon monoxide, ammonia, benzene, nitrogen oxides, vapours of alcohol), temperature, humidity.

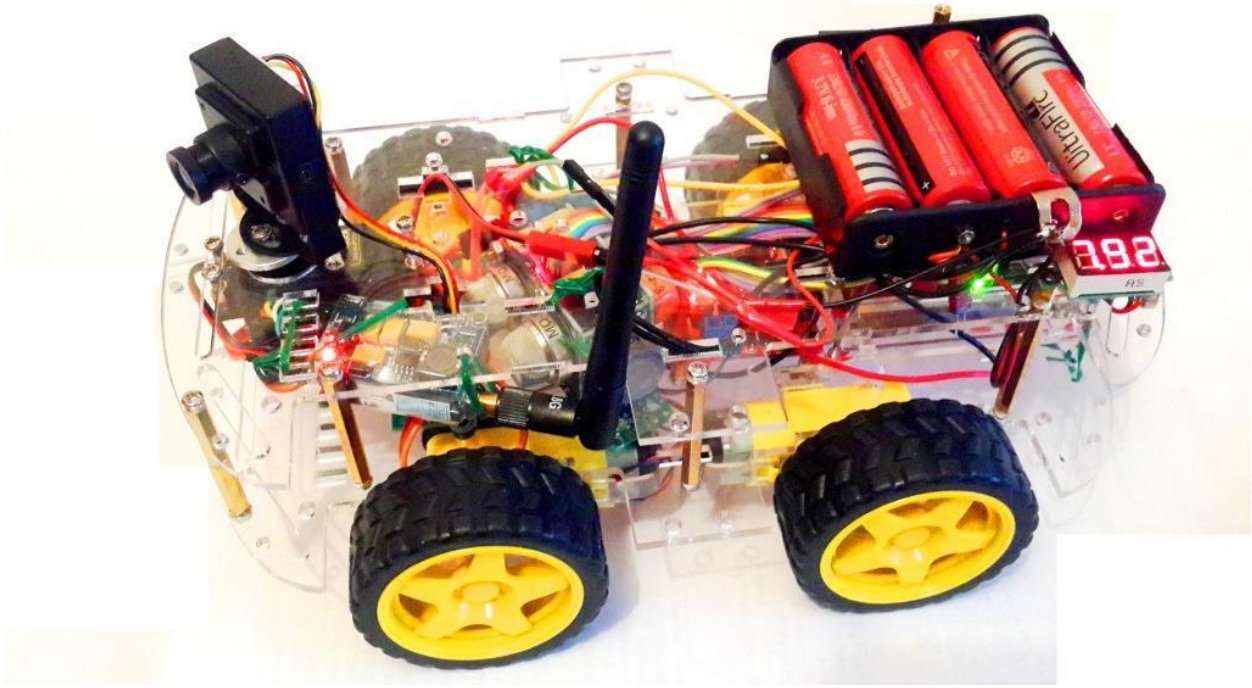

Figure 1 - Wheeled robot "Observer - chemical reconnaissance".

Table 1

The performance characteristics of wheeled robot "Observer - chemical reconnaissance".

№	option	value
1	Dimensions (length, width, height)	0,28 m / 0,17 m / 0,2 m
2	Clearance	0,015 m
3	Weight	1,2 кг
4	Maximum speed	1.4 м/с (5 km/h)
5	The carrying capacity	~1 кг
6	Remote control	from computer, with the tablet smartphone
7	The range of remote control via Blutooth	up to 100 m
8	The range of remote control via WiFi	up to 300 m
9	The ultrasonic sensor (determination of distance to objects)	up to 50 m
10	Voltage / capacity / continuous operation time of battery R. O.	7-10 B 2 x 3,7 B x 4800 A/h up to 0.5 h
11	The range of video surveillance systems	up to 300 m
12	The ability to install various sensors (radiation, temperature, humidity, illuminance, etc.)	Yes
13	Indication of sensors on the robot	16*2 blue LCD screen
14	Moisture	No
15	The possibility of two-way voice communication	Yes
16	Panoramic view of the area (rotation only)	180^0
17	Installed sensors for dangerous concentrations of gas	**MQ-2** Sensor to detect combustible gas and smoke (propane, methane, n-butane), smoke (suspended particles resulting from combustion) of hydrogen. **MQ-3** Sensor for vapour detection alcohol C2H5OH **MQ-4** Sensor detect natural gas and methane (CH4) in the air, vapors of alcohol, cigarette and cooking smoke. **MQ-5** Sensor for detecting liquefied (LPG), natural and coke oven gas. Used for alarm gas leaks in the home and in the workplace. **MQ-6** Sensor for detecting LPG, ISO-butane, butane. (natural gas, petroleum gas, butane, propane) **MQ-7** Analog sensor to detect carbon monoxide (CO). Used to detect CO2 at the plant, when carrying out underground work in the laboratory and scientific works. It can detect CO-gas concentrations in the range of 20 to 2000 ppm. **MQ-8** Sensor for detecting Hydrogen (H2) gas and coke oven gas.

		Easy to use sensor hydrogen (H2) to determine whether it is in the air. **MQ-9** Combined analog gas sensor (CO+CO or CNG+LPG) (propane, methane, n-butane) and carbon monoxide (CO). **MQ135** gas Detector In addition to carbon dioxide, the sensor also reacts to the presence of other gases: carbon monoxide, ammonia, benzene, nitrogen oxides and vapors of alcohol. Apply for permanent air quality monitoring in industrial or domestic premises.

Materials and Methods

Programming of the microcontroller the robot will implement the designed program:

```
#include <Servo.h>
//#include <Ultrasonic.h>
//#include <Time.h>
//#include <Wire.h>
//#include <iarduino_MultiServo.h>
//iarduino_MultiServo MSS;
//#include <PCA9685.h>
//#include <pwmservodriver.h>
//#include <LiquidCrystal_I2C.h>
//LiquidCrystal_I2C lcd(0x27, 16, 2);
//#include <dht11.h>
//#define DHT11_PIN A0
//dht11 DHT;

const int motor1 = 5;
const int motor1b = 6;
const int motor2 = 3;
const int motor2b = 4;
int x,s,lcdon;
int b,Le;
const int driveA = 2;
const int driveB = 7;
int drive;

int k1,k2,k3,k4,s1,s2,M,M1;
int blue,Kvad,Kd;
int dist=0;
int t=0;

int chk;
String msg;
int MQ1,MQ2,MQ3,MQ4,MQ5,tt,hh,d,d1,d2,t0,povorot,di;
char sss[8];
char incomingByte;
Servo servo1;

//Ultrasonic ultrasonic(8, 9);
// setTime( 23, 50, 50, 10, 10, 2016 );

void setup() {
```

```
  // put your setup code here, to run once:
servo1.attach(11);
  Serial.begin(9600);

pinMode(motor1, OUTPUT);
pinMode(motor1b, OUTPUT);
pinMode(motor2, OUTPUT);
pinMode(motor2b, OUTPUT);
pinMode(driveA, OUTPUT);
pinMode(driveB, OUTPUT);
pinMode(10, OUTPUT);
//pinMode(A0, INPUT);
pinMode(A1, INPUT);
pinMode(A2, INPUT);
pinMode(A3, INPUT);
pinMode(A4, INPUT);
pinMode(A5, INPUT);


x = 0; drive=0;
blue = 1;
digitalWrite(10, HIGH);
s=66;
s1=75;
s2=130;
servo1.write(88);//60-130
Le=0;
di=0;
Kvad=0;
lcdon=0;

  M1=0;
 t=0;
drive=0;
}

void loop() {   // put your main code here, to run repeatedly:

if (Le == 1){
MQ1 = analogRead(A1);
MQ2 = analogRead(A2);
MQ3 = analogRead(A3);
MQ4 = analogRead(A4);
MQ5 = analogRead(A5);
msg                                                                                                    =
"M"+String(MQ1)+"___"+"N"+String(MQ2)+"___"+"O"+String(MQ3)+"___"+"P"+String(MQ4)+"___"
+"R"+String(MQ5)+"_____";
Serial.print(msg);

t=t+1;
if (t>50){ t=0;Le=0; digitalWrite(10, HIGH);}
}

  if (Serial.available() > 0) {
    incomingByte = Serial.read();
    if(incomingByte == 'U') { Le=1; digitalWrite(10, LOW);   }
    if(incomingByte == 'u') { Le=0; digitalWrite(10, HIGH);    }

  //if(incomingByte == 'X'){lcdon=1;  lcd.backlight();}
```

```
  //if(incomingByte == 'x'){lcdon=0;  lcd.noBacklight();}

  //  if(incomingByte == 'V') { b=1;    }
   // if(incomingByte == 'v') { b=0;    }
  //  if(incomingByte == 'V'){di=1; }
  //  if(incomingByte == 'u'){di=0; }

if(incomingByte == '2') { servo1.write(140);}if(incomingByte == '3') {
servo1.write(120);}if(incomingByte == '4') { servo1.write(100);}if(incomingByte == '5') {
servo1.write(80);}
if(incomingByte == '6') { servo1.write(66);}if(incomingByte == '7') { servo1.write(40);}if(incomingByte
== '8') { servo1.write(20);}if(incomingByte == '9') { servo1.write(0);}

//if(incomingByte == '2') { MSS.servoWrite(15,140);}if(incomingByte == '3') {
MSS.servoWrite(15,120);}if(incomingByte == '4') { MSS.servoWrite(15,100);}if(incomingByte == '5') {
MSS.servoWrite(15,80);}
//if(incomingByte == '6') { MSS.servoWrite(15,66);}if(incomingByte == '7') {
MSS.servoWrite(15,40);}if(incomingByte == '8') { MSS.servoWrite(15,20);}if(incomingByte == '9') {
MSS.servoWrite(15,0);}


   if(incomingByte == 'F') {drive=1; M=1; motorClear(); motor();     } //вперед
   if(incomingByte == 'B') {drive=1; M=2; motorClear(); motorB();    } //назад
   if(incomingByte == 'L') {drive=1; M=3; motorClear(); motorL();    }
   if(incomingByte == 'R') {drive=1; M=4; motorClear(); motorR();    }

if (drive==1){motorOn();delay(20);motorOff();};

if (di==1){
while (incomingByte > 'B' || incomingByte < 'B' ) {
  if (Serial.available() > 0) {  //если пришли данные
    incomingByte = Serial.read(); // считываем байт
  delay(30); };
//if (ultrasonic.Ranging(CM)<8 && ultrasonic.Ranging(CM)>0){incomingByte = 'u';};
};

motorClear();
motorOff();
};
  }else{drive=0;}
motorClear();
}

void motorOnR(){
digitalWrite(driveA, LOW);
digitalWrite(driveB, HIGH);
}
void motorOnL(){
digitalWrite(driveA, HIGH);
digitalWrite(driveB, LOW);
}

void motorOn(){
digitalWrite(driveA, HIGH);
digitalWrite(driveB, HIGH);
}

void motorOff(){
digitalWrite(driveA, LOW);
```

```
digitalWrite(driveB, LOW);
//motorClear();
}

void motorClear()
{digitalWrite(motor1, LOW);
digitalWrite(motor2, LOW);
digitalWrite(motor1b, LOW);
digitalWrite(motor2b, LOW);
}

void motor(){
digitalWrite(motor1, HIGH);
digitalWrite(motor2, HIGH);
digitalWrite(motor1b, LOW);
digitalWrite(motor2b, LOW);
}

void motorB(){
digitalWrite(motor1b, HIGH);
digitalWrite(motor2b, HIGH);
}

void motorL(){
digitalWrite(motor1b, HIGH);
digitalWrite(motor2, HIGH);
}

void motorR(){
digitalWrite(motor1, HIGH);
digitalWrite(motor2b, HIGH);
}

void motorOnThenOffWithSpeed()
{
int Speed1 = 200; int Time1 = 3000;
int Speed2 = 50; int Time2 = 3000;
digitalWrite(motor1b, LOW);
digitalWrite(motor2b, LOW);
analogWrite(motor1, Speed1); analogWrite(motor2, Speed1); delay(Time1);
analogWrite(motor1, Speed2); analogWrite(motor2, Speed2); delay(Time2);
}
```

Figure 2 - Developed control program.

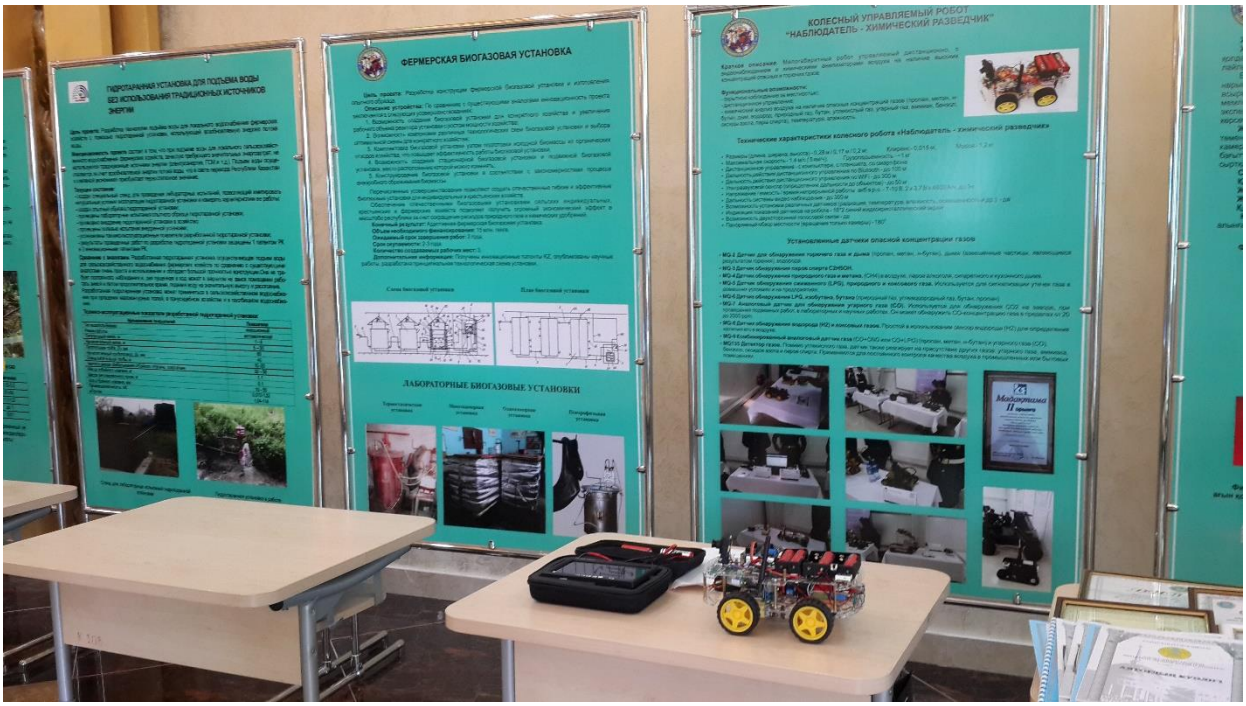

Figure 3 - Stand and demonstration of the robot (August 23, 2016) .

Conclusion

This project to develop a gas analyzer station based on the robot participated in the competition of robotics in the framework of military training Aibyn 2016 and took 2nd place, as well as in the exhibition of achievements of 23 August 2016.

The developed robot is able to reach inaccessible places to the operator transmitting video as well as producing chemical reconnaissance of combustible gases.

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