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|---|---|---|---|---|---|
| | **ISRA** (India) = **1.344** | **SIS** (USA) = **0.912** | **ICV** (Poland) = **6.630** |
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| | **JIF** = **1.500** | **SJIF** (Morocco) = **2.031** | |

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**SECTION 2. Applied mathematics. Mathematical modeling.**

# DEVELOPMENT OF AN AUTOMATIC DUST COLLECTION SYSTEM IN MINES

***Abstract***: *The proposed automated system designed on the microcontroller for sampling dust in mines.*
***Key words***: *microcontroller, dust, mine.*
***Language***: *English*
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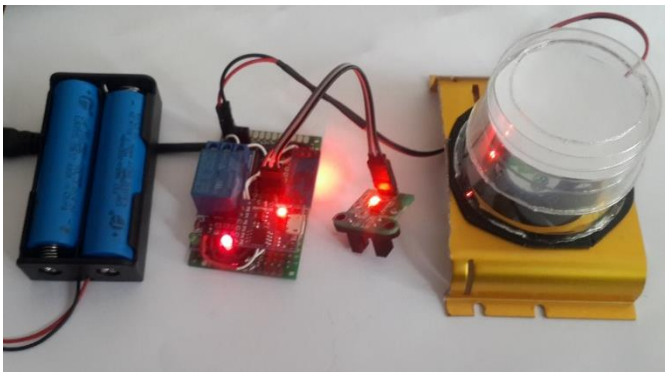
## Introduction

In the study of blasting in mines the use of automatic data collection systems relevant and justified. It uses a different blasting technology [1-6]. The studied coal mine dust as a collection of fine mineral particles produced from fossil coal and gangue and are suspended or settled status in mine workings. The size of the dust particles in the diameter range from 1 mm to fractions of a micron [7-9]. According to the size of the dust is divided into three classes. The first class includes the dust with particle size more than 10 microns. Such particles are deposited relatively rapidly on the soil and sides of the development and comprise the bulk of the settled dust. The second class includes the dust with a particle size of from 10 to 0.1 μm. These particles are a long time in suspension and are transported long distances by ventilation air flows in mine workings. To the third class carry dust with particle sizes less than 0.1 μm, which practically does not settle out of the air. Dust second and third class in the air in a suspended state, called soaring.

## Materials and Methods

Develop an automatic system for the analysis of dust concentration. And with a sharp increase will trigger the device dust extraction from the air at a certain specified time.



**Picture 1 - Dust Sensor with microcontroller.**

**Equipment and cost**

| | Title | The cost of components (tg.) |
|---|---|---|
| 1 | The Microcontroller Attiny85 | 500 |
| 2 | Relay module | 300 |
| 3 | Fee | 150 |
| 4 | Sensor dust | 1400 |
| 5 | Voltage stabilizer | 100 |
| 6 | Connectors:<br>1x6 – 1pc.<br>1x4 – 3pcs<br>Connecting wire, shrink and connectors | <br>15<br>45<br>500 |
| 7 | Cooler | 1000 |
| 8 | Li-ion battery<br>2 PCs*3.7 V | 1000 |
| 9 | Holder battery | 300 |
| | Total | 5310 |

**The program for the microcontroller**

```
int Time=10;  //секунд
int DatState,b;
void setup() {
pinMode(1, INPUT);
pinMode(0, OUTPUT);
b=1;
digitalWrite(0, HIGH);
}

void loop() {
if (b==1) {
int DatState = digitalRead(1);
if (DatState==HIGH) {b=0;
digitalWrite(0,LOW);
delay(Time*1000);
digitalWrite(0,HIGH);
}}
}
```

**Description of Dust Sensor- Model:SDSM501ADS**

The dust sensor module DSM501A is low cost, compact size for a particle density sensor.it is used to quantitative particle (> 1 micron) measurement with the principle of particle counter, can sense the tobacco smoke and pollen, house dust [7-8]

This sensor is consist of light emitting diode lamp, detector, signal amplifier circuit and heater, it can be used in applications such as the air cleaner or air purifier, users can used this sensor easily with sensor PWM output.

**The program for the microcontroller with sensor dust, temperature, humidity and concentration of carbon monoxide.**

```
#include <dht11.h>
dht11 DHT;
#define DHT11_PIN 8
#include<string.h>
byte buff[2];
int pin = 9;//DSM501A input D9
unsigned long duration;
unsigned long starttime;
```

```
unsigned long endtime;
unsigned long sampletime_ms = 5000;
unsigned long lowpulseoccupancy = 0;
float ratio = 0;
float concentration = 0;
int i=0;
float MQ,MQ0;

void setup() {
  // put your setup code here, to run once:
Serial.begin(115200);
  Serial.println("DHT TEST PROGRAM ");
  Serial.print("LIBRARY VERSION: ");
  Serial.println(DHT11LIB_VERSION);
  Serial.println();
  Serial.println("Type,\tstatus,\tHumidity (%),\tTemperature (C)");
  pinMode(9,INPUT);
  starttime = millis();
pinMode(A0,INPUT);
}

void loop() {
  // put your main code here, to run repeatedly:
 int chk;
  Serial.print("DHT11, \t");
  chk = DHT.read(DHT11_PIN);    // READ DATA
  switch (chk){
    case DHTLIB_OK:
                Serial.print("OK,\t      ");
                break;
    case DHTLIB_ERROR_CHECKSUM:
                Serial.print("Checksum error,\t");
                break;
    case DHTLIB_ERROR_TIMEOUT:
                Serial.print("Time out error,\t");
                break;
    default:
                Serial.print("Unknown error,\t");
                break;
  }
 // DISPLAT DATA
  Serial.print(DHT.humidity,1);
  Serial.print(",\t    ");
  Serial.print(DHT.temperature,1);

MQ0 = analogRead(A0);
MQ =map(MQ0, 0, 1023, 0, 100)/100;
    Serial.print("           MQ : ");
    Serial.print(MQ);
    Serial.print(" %     ");
    Serial.println(MQ0);

  duration = pulseIn(pin, LOW);
  lowpulseoccupancy += duration;
  endtime = millis();
  if ((endtime-starttime) > sampletime_ms)
  {
    ratio = (lowpulseoccupancy-endtime+starttime + sampletime_ms)/(sampletime_ms*10.0);  // Integer percentage
0=>100
```

```
  concentration = 1.1*pow(ratio,3)-3.8*pow(ratio,2)+520*ratio+0.62; // using spec sheet curve
  Serial.print("lowpulseoccupancy:");
  Serial.print(lowpulseoccupancy);
  Serial.print("    ratio:");
  Serial.print(ratio);
  Serial.print("    DSM501A concentration:");
  Serial.println(concentration);

concentration = 1.1*pow(ratio,3)-3.8*pow(ratio,2)+520*ratio+0.62; // using spec sheet curve

  lowpulseoccupancy = 0;
  starttime = millis();
 }

 delay(1000);
 }
```

**Conclusion**

The developed device was tested and can be used for dust extraction in automatic mode. The developed algorithms and the device will be used in research works in the Karaganda coal mines.

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