Measuring the change of air temperature with 8 LM75A sensors in mining area

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Abstract. The studied geographical area is situated in a intramontane region situated on the Jiu River called the Jiu Valley, where the main economic activity is mining. The importance of studying this area is related to the effect of coal mining on the climate. Coal extraction in the area led to a change of atmospheric temperature due to the emissions of gases and dust that affects the environment. The use of LM75A sensors allow us to accurately read the air temperature and transmit warning messages when certain temperature intervals are exceeded.

1 Introduction

The Petrosani Depression is part of the Jiu Valley and is the largest depression in the country. It has a tectonic origin and expands to east-west direction 43-45 km and widens 3-9 km on the courses of the two main tributaries of "Jiu" river. The city of Petrosani has an elongated shape and is surrounded by mountains, which is why the circulation of air masses has a north to south direction, through the exits Bănița-Merișor and Surduc-Lainici.

Due to its geographical position and altitude, Petrosani's climate should be sub-mountainous, but if we consider the temperature of the hottest month (July, with an average of 16.7 ° C) and the average annual temperature (6.8º), it is getting closer to the low altitude mountain climate. July temperatures are 3-4 ° C higher than the rest of the months and annual temperatures are 2-3 ° C higher than the areas with a sub-mountain climate. Warm days with average temperatures above 10 ° C are less in Petrosani than in other regions considered colder. The number of summer days with temperatures above 25 ° C is about 50 days. The average annual rainfall is 700-800 mm / year.

There is an interesting thermal phenomenon in the city called thermal inversion. This process represents some stagnation and cooling of the air coming down from the heights of the mountains to the city. Under the influence of stagnation and cooling, the lowest temperatures exceed minus 30 ° C (-31.4 ° C on January 14, 1893), while at Parang station located 900-1000m above, the lowest temperatures did not exceeded - 24 ° C. Thus, in winter the frosts are stronger in Petrosani than on the surrounding heights, but not longer.

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The sedimentary complex of the basin belongs to the Upper Cretaceous, the Upper Oligocene and the Miocene and is transgressively and discordantly disposed over the palaeo-mesozoic crystalline formations.
In the productive formation, of oligocene age, at the beginning there were identified about 20 layers of coal. The useful substance in the deposit is made up of coal with compact and relatively homogeneous composition. The coal of the Jiu Valley, which is superior to most of other coal found in our country, is a hard type coal. The main economic activity in the area is coal extraction.[3]

The transition to systematic extraction of coal in this basin, on an industrial scale, was only made at the end of the 19th century.[3]

Due to the industrialization of this area and human activities, the balance of the environment is weak. The mining activity includes the coal extraction, transport, storage and its transformation into energy. These activities are responsible for the pollution of the environment with sulfur oxides, nitrogen, suspended powders, soot and carbon dioxide, especially in the surrounding areas where coal deposits are usually found. All these gas emissions, once released into the atmosphere, affect both human health and the environment. For example, methane emissions into the atmosphere have a lifetime of about 12 years and although it is considered a gas with a relatively short lifetime, it has sufficient time to be transported to other regions. Another negative factor of this gas is that methane is a greenhouse gas that also contributes to the formation of ozone from the ground level, which is itself a major pollutant that affects human health and the environment. The particles resulting from the transport of coal, the removal of air from the underground and the transformation of coal represent a complex pollutant because, depending on their composition, they may have a cooling or heating effect on the local climate. For example, the particles resulting from the combustion of coal have a dark color and if they are released into the atmosphere will absorb solar radiation and have a heating effect on the environment, hence the increase of air temperature.[6]

2 Results and discussions

During this study, to monitor the temperature values, several temperature values were collected from different parts of the city, with the help of 8 LM75A type sensors connected to a Raspberry Pi Zero device.

Raspberry Pi Zero is a SBC (Single-board computer) with a size of a credit card, which has input / output ports that offers the possibility to connect various electronic components specific to the systems such as sensors, buttons, LCD screens, relays., in order to create new electronic projects.[5]

The LM75A is an industry-standard digital temperature sensor with an integrated analog-to-digital converter and I2C® interface. The LM75A provides 9-bit digital temperature readings with an accuracy of ±2°C from -25°C to 100° C and ±3°C over -55°C to 125°C. The LM75A operates with a single supply from +2.7V to +5.5V. Communication is accomplished over a 2-wire interface which operates up to 400 kHz. The LM75A has three address pins, allowing up to eight LM75A devices to operate on the same 2-wire bus. The LM75A has a dedicated over temperature output (O.S.) with programmable limit and hysteresis. This output has programmable fault tolerance, which allows the user to define the number of consecutive error conditions that must occur before O.S. is activated.[4]

The designed circuit ensures the interconnection of 8 temperature sensors each with its own I2C® address, in order to determine the instantaneous or average temperature in the place where it is located. This circuit can be connected to any device that can communicate through the I2C protocol, in our case it is connected to a Rapberry Pi Zero board. The main purpose of this circuit was the easy connection with devices such as arduino / raspbery pi

(or other devices with the ability to communicate through the I2C protocol) and obtain the most accurate temperature values. The maximum read speed of the data from the 8 temperature sensors is 400 kHz, resulting in over 20,000 thousands of temperature readings per second. In addition to reading the temperature, this circuit can also be used to alarm the exceedance of certain temperature ranges.[1]

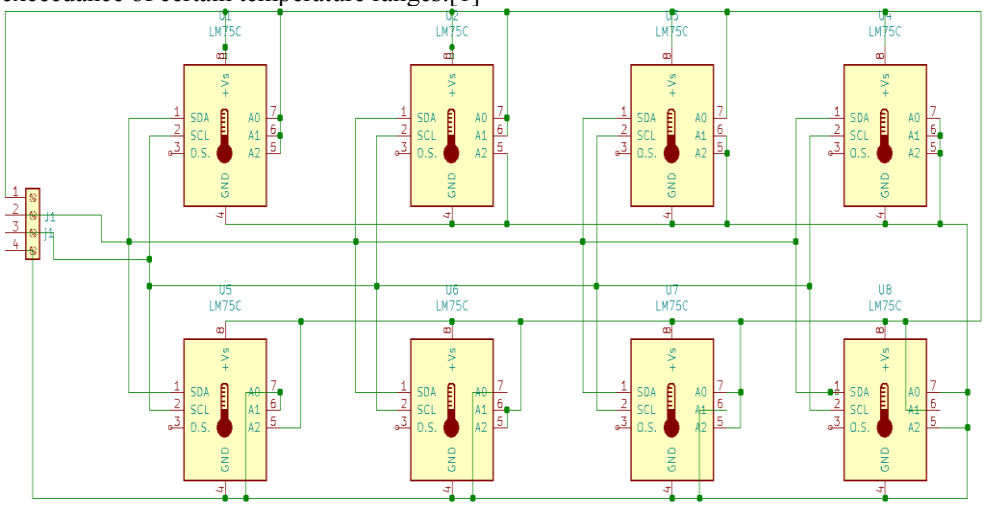

Fig. 1. Connection diagram for the 8 LM75A sensors.

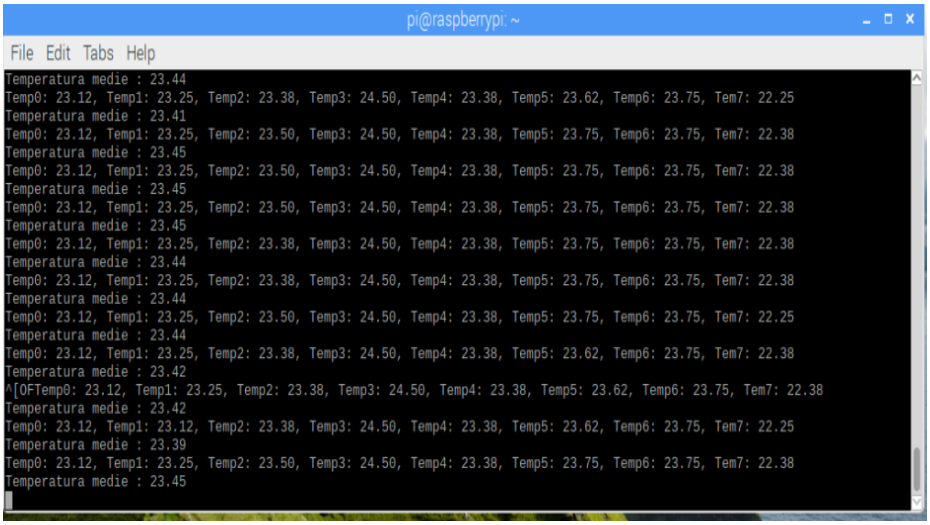

Fig. 2. Capture of the values recorded by sensors.

The sensors were located in two different parts of the city, more precisely in the south and in the north, so that we can determine different temperature values. The measurements were made over a period of three months, namely the months of May, June and July, from which we chose different days to make comparisons between the values from different parts of the city. The data read by the sensors are collected in a database for their verification, validation and maintenance, and the results obtained are available to the users. In case of exceeding certain selected intervals the device can be set to send warning messages to the user.

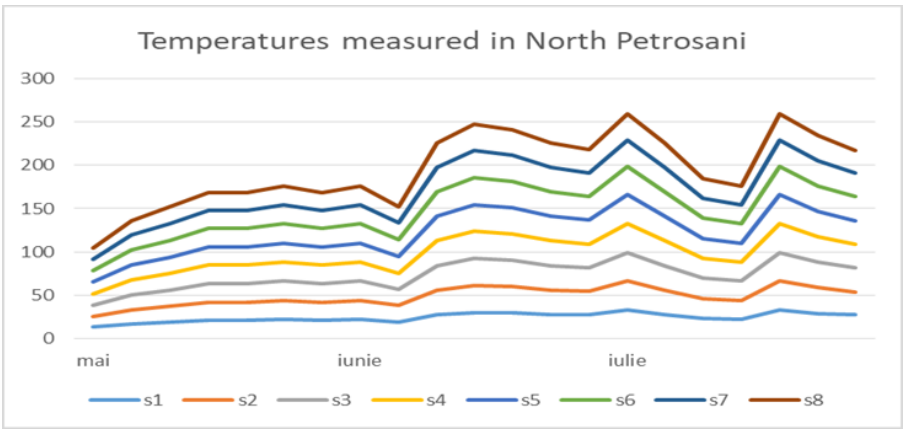

Fig. 3. Variation of temperature in the north of the Petrosani

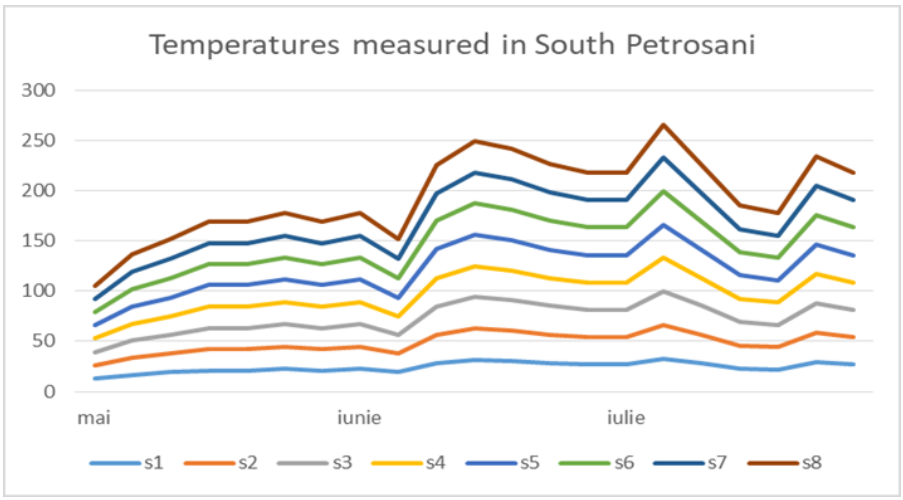

Fig. 4. Variation of temperature in the south of the Petrosani

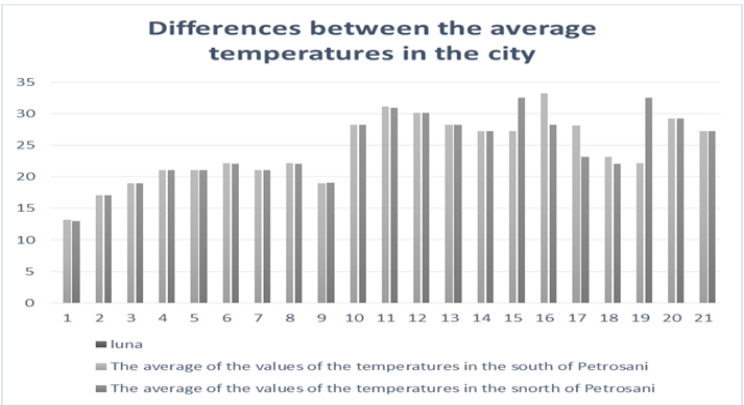

Fig. 5. The variation of the average values of the measured temperatures

Figures 3 and 4 represent the temperature variation in the north and south of the city, temperatures measured using the 8 LM75A sensors, and figure number 5 shows the differences between the monthly averages in the two areas.

3 Conclusions

The need to implement environmental quality monitoring programs became clear when we became aware of the problems generated by pollution, the risks to human health and the environment in general, the destruction of ecological balances, ecological disasters, the ozone layer and global warming, all these leading to the change of environment and more and more phenomena of severe intensity or more and more diseases.

Monitoring the air temperature is very important because excessive air heating known as hyperthermia and excessive air cooling known as hypothermia affect good functioning of the environment and living organisms.

The created system is easy to use, friendly and thanks to the interconnection of the 8 sensors LM75A offers precise data readings of the surface temperature we want to measure.

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