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REAL IMPACT OF THE MICROCLIMA CHANGES TO WORKERS WHO CIRCULATE FROM HOT TO COLD CHAMBERS - A PART FROM AN EXTENSIVE RESEARCH INTO INDUSTRIAL ENTITY

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Abstract: The basic aim of the paper is to present a real overview of the work conditions into a real industrial entity with production activities in Republic North Macedonia. The same one has more than 100 employees in 3 locations. The basic challenge of the paper and the innovation in this matter is the created measurement instrument by our side, which was specially made with an sophisticated software in behind which could measure precisely temperature and humidity and could memorize the data every 3 seconds in mini SD card placed into the instrument. Whit this kind of an instrument we could gather a large amount of data, in small intervals, from which we could see the real conditions. Also the instrument is a portable one, and the same one could be placed on a human arm and could be transferred from one place to another as the worker is doing his job on a daily base. But one of the main reasons why this kind of an instrument is created is because the same one could be use in real entities, where workers because of their daily activities have a temperature shocks from one place to another (from 3 or even – 4 degree Celsius temperatures to even + 45 degrees Celsius). So the paper presents only a small part from an ongoing research with a main purpose to aim a real solution regarding work conditions and work instructions, but also a real health and safety protection to workers that are involved to such an activities. And at the end of the introduction part, we could say that this paper is only the beginning of a paper release from several reasons such as: multiple instrument was created and they are used on a daily base in industrial entity (not only this one), the research was done in several occasions with multiple measurement in different time frames, different outside temperatures, the measurement is also conducted with an calibrated instrument which is an professional one for this purpose and the results are with small deviations.

Key words: *Measurement, Health and Safety, Microclimate, Quality Control, OSHAS, QMS*

1. INTRODUCTION

The entity presented into the papers is a part of the multiple measurement treatment is a production capacity with production systems in three different locations in Republic North

Macedonia, and a marketing and trading activities in the country but also into the region – Balkans. The production system which was an aim of research has an production activities which according to the technology processes is divided to units which starts whit storage units for raw materials and ends with storage units for final products. The production processes into the production units are planned with a circulation of workers from the so-called hot chambers to cold chambers and often with a direct circulation of workers from hot to cold rooms. The spotted activities were one of the main reasons why the research started. At the moment of research the number of employees was from 100 to 120 employees regarding work activities, from which only a small part are the so-called administrative workers, small part (less than 10) responsible for commercial activities, and the most of them directly into production processes. More than 15 workers from the production processes are directly involved in activities with wet surfaces and a circulation from hot to cold chambers, which could be a professional problem and also a health and safety reason. So that is also one of the main reasons why multiple measurements were done in several occasions so the real picture could be seen.

2. PRESENTING THE MEASUREMENT METHOD AND THE CREATED UNIT

Considering the fact that we are speaking of a measurement instrument which was not bought as one, and speaking about a measurement from which we could see the real condition into a industrial capacity where an immediately actions should be taken – we should start this part with the system for an active collection of data.

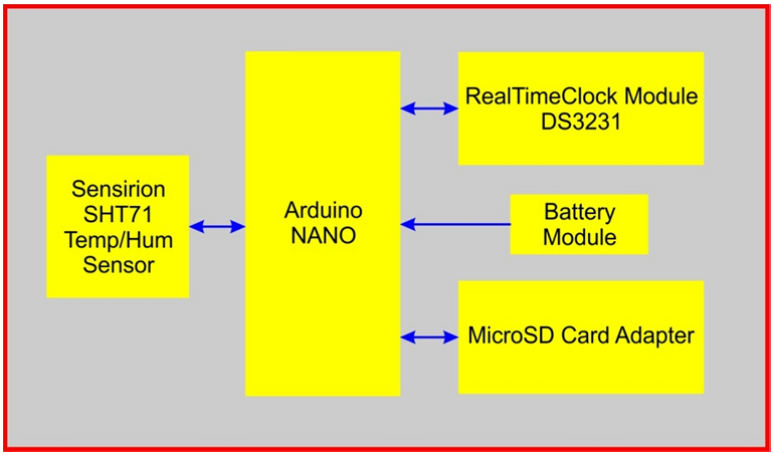

Fig.1: Temp/Hum sensor node structure

The sensor node is based on Arduino Nano MCU, with a Battery power supply. The actual time and date are obtained from the DS3231 based RTC module. The measured data is stored on a microSD card in * .CSV format.

And so we could get a real data, before we even started the measurements the created unit is compared with even 2 other high quality measurement unit – professional ones so we could get a real overview about the % of mistake and the tolerance level. And after multiple measurements into different areas we could conclude that the created measurement unit (one

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presented above) is created and calibrated so the one could be used and the data gathered could be seen as real ones.

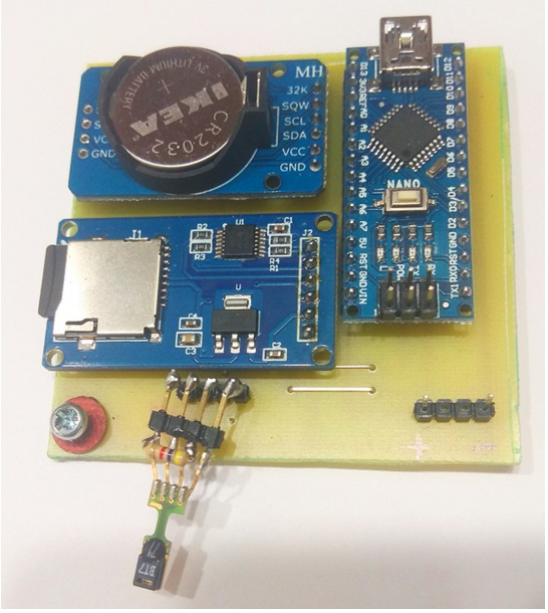
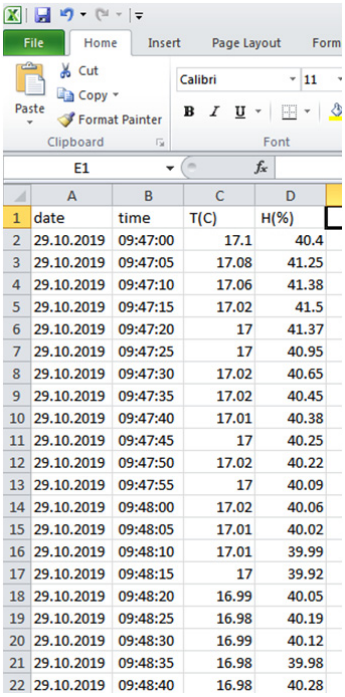


Fig.2: Temp/Hum sensor node real PCB

After numerous measurements and comparative analysis of the data, real data were obtained with very small deviations. Comparison of measurement results is done with reference instruments for measuring temperature and humidity by reputable manufacturers.



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E1

	A	B	C	D
1	date	time	T(C)	H(%)
2	29.10.2019	09:47:00	17.1	40.4
3	29.10.2019	09:47:05	17.08	41.25
4	29.10.2019	09:47:10	17.06	41.38
5	29.10.2019	09:47:15	17.02	41.5
6	29.10.2019	09:47:20	17	41.37
7	29.10.2019	09:47:25	17	40.95
8	29.10.2019	09:47:30	17.02	40.65
9	29.10.2019	09:47:35	17.02	40.45
10	29.10.2019	09:47:40	17.01	40.38
11	29.10.2019	09:47:45	17	40.25
12	29.10.2019	09:47:50	17.02	40.22
13	29.10.2019	09:47:55	17	40.09
14	29.10.2019	09:48:00	17.02	40.06
15	29.10.2019	09:48:05	17.01	40.02
16	29.10.2019	09:48:10	17.01	39.99
17	29.10.2019	09:48:15	17	39.92
18	29.10.2019	09:48:20	16.99	40.05
19	29.10.2019	09:48:25	16.98	40.19
20	29.10.2019	09:48:30	16.99	40.12
21	29.10.2019	09:48:35	16.98	39.98
22	29.10.2019	09:48:40	16.98	40.28

Fig.3: Log.csv file example

Considering the fact that this industrial entity is chosen so we could have an comparative overview, but also that we could get an real picture about the entity, the same one as an entity is chosen for the following reasons: Work regime and the technology process where a circulation of employees is a daily routine with activities in units with very different microclimate conditions

- Industrial capacity where monitoring system is already placed
- Number of employees who are enrolled in changes from minute to minute which have a negative influence to the health of the same ones.

3. PRESENTING A DAILY VIEW OF THE DATA

Considering the fact that multiple measurements are conducted into the industrial entity which is a main point of research, in several time frames – different ones, in different days in different parts of the year (winter –summer), the tabular view presented into the paper is only a day presentation. But although the same one is a day presentation of the gathered data, we could see the circulation of workers and the indoor conditions. For comparison the measurement is done in a day in which the outside temperature was 16.1 Celsius degree and the humidity was 40.1%.

The given tabular view in addition is only a small part of what we saw and measured, but what is a daily routine for the workers. The same ones (more that 15 employees) have a circulation regarding production activities from hot to cold chambers multiple times per day. So that is why the tabular view is a presentation of a 60 minute daily routine of one worker which has a various circulations: from hot to cold chamber, from production to cold chamber, from cold to hot chamber, from production to hot chamber. In addition the tabular view is the best presentation of the work conditions.

Table 1: Part of the measured results

	Time of measurement (local time)	**Temperature (^{o}C)**	**Humidity (% RH)**
1	9:00	17.9	47
2	9:15	23.1	51.2
3	9:20	21.5	56.3
4	9:25	10	62.7
5	9:30	6.9	70
6	9:35	3.2	48.5
7	9:40	13.5	51.8
8	9:50	41.6	50.8
9	10:00	19.5	50.8

Although this kind of an interoperation and presentation of data (from an hour to a hour) is with a large time gap, the same one is a real interpretation of a real condition and a circulation of a person into the industrial entity, where according to the data aimed the same one is involved in production activities with temperatures from 3.2 to 41.6 Celsius degrees

and a humidity from 47 – 70 %. But the tabular view is only a small part and a daily activity of worker. Multiple measurements were made and the same ones could be placed into future publications.

4. CONCLUSION

The paper present only a small part from an extensive research conducted with a wisely chosen methodology and created measurement unit in which 2 sensors are placed. The unit created is calibrated and comparatively involved in a measurement with a measurement unit with high price and a small tolerance. Actually what is a real thing to mention from this paper is the measurement unit created for the purpose of this measurement which has an unique software that could data every measurement with a diapason of 3 second from one to another measurement. So the same one could gather information about a real activity and a short notice change of the rooms (hot to cold, cold to hot) which could be a health and safety problem to the entity and especially to the workers. And finally seeing that the aimed data and the results from the measurement are a real data base with a large amount of data, from which a long term activities with an aim to improve the work conditions are made, some future publications are also coming in a near future.
Guidelines for further improving: Creating a sensor node with web-based application for on-line data collection using the wireless sensor networks.

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