

Smart Grain Storage Monitor and Control

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Abstract

Although we are living in an era of fast development in the technology of monitoring and controlling in the field of storage houses, Egypt still suffers from a huge scandals in this field especially in field of wheat that considered to be the main source of nourishment in Egypt that the poor people who represents the majority, depends on. From this point the proposed system suggested a new technique that never implemented before in Egypt to face the problems of huge costs that reaches up to billions of pounds, also the illegal addition of false quantities of wheat and the uncontrollable of the environment inside storage houses. The new technique depends on measuring the level of grains inside silos through an efficient level sensors and monitoring the environment through environmental sensors, all these parameters will be sent periodically to the main station via GSM module, and will be displayed automatically on the LCD. Through this device we tried to decrease the human interface and decrease any manipulation and fraud that is available in the current alternative systems.

Keywords: Smart monitor and control; Grain houses; Silos; Monitoring and controlling silos; Wheat corruption; Solutions to monitor and control silos in Egypt.

1. Introduction

Due to the circumstances that Egyptian society passes through and increasing wheat consumption by the Egyptians in their daily consumption of food which presents about 70% and the need of producing high quality and higher quantity of wheat to meet the local needs and reduce imports, silo was made to be a suitable environment to store the wheat. As wheat is the main source of nourishment in Egypt. Lately the country suffers from the wheat corruption issue that costs a millions of dollars and that lead us to divide the problem into two parts:

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i. Generally:

- Wasting millions of dollars.
- The needs of reducing imports.
- Ending the shortage in wheat reserves.

ii. Technically:

- The weak techniques used to monitor and control the storage house that allows the adding or removing of false quantities of grains.
- The needs of monitoring and controlling the environment inside the silo.

2. Current Alternative Systems

2.1 Manual Systems

- **Methodology**

Although it is considered to be very weak and old systems, yet it is the widest used techniques in Egypt. The main idea is that the wheat or grain is weighed before and after it enters the silo through weight scale then the observer (human being) register the results before and after in each time. Another way used to measure the level through knocking the wall at different levels outside the silo.

- **Advantages**

- 1) Simplicity of the system.
- 2) Inexpensive.
- 3) Ease of usage.

- **Disadvantages**

- 1) Inaccurate results.
- 2) Observer errors.
- 3) Ease of modification on results.
- 4) Time Consuming.

2.2 Automatic Systems

- **Methodology**

This type of systems took place in Egypt with the beginning of 2016. It uses a new and automatic techniques to monitor and control the grain storage houses so it can repair what be corrupted on the manual systems. The main idea of automatic systems is to continuously measure the level inside the silo through satellite nourishes and

complex sensor. The system also controls the environment inside silo.

- **Advantages**

- 1) High efficiency in detecting errors.
- 2) Difficult to modify it.
- 3) An elaborate system.

- **Disadvantages**

- 1) Designed by a foreign company.
- 2) The cost is very high.
- 3) High cost maintenance.

3. Smart Grain Storage Monitor and Control

3.1 Methodology

As per overview a few issues had been distinguished, for example, confronting the old techniques used that led to time consuming, inaccurate ways in detecting errors and led also to huge scandals in the field of grain storage houses that costs Egypt millions of dollars. Therefore, the proposed system provides a new and efficient solution to monitor and control the storage houses through using an ultrasonic sensor attached to servo motor that will scan the surface of the gain [1, 2]; this will prevent the addition of false quantities. Moreover, the environment will be monitored through environment sensors to continuously measure the temperature, humidity and air flow and taking a certain actions if any of these parameters exceeds the fixed value, by activating the fan or heater to control the environment inside the storage house [3]. All the parameters will be sent to the main station through GSM module, the results than will be displayed on LCD [4, 5].

3.2 System Description

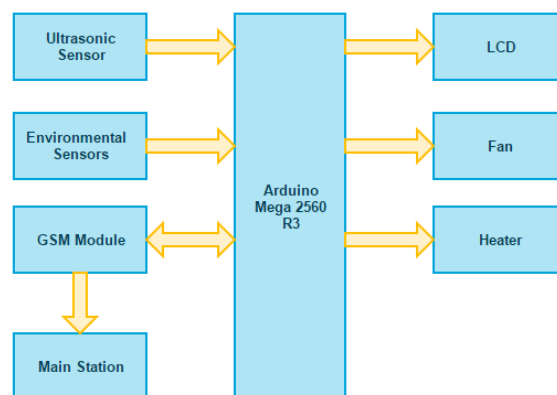


Figure 1: Block diagram of Smart Grain Storage Monitor and Control

As shown in Figure1 the block diagram the proposed system will consists of Arduino Mega 2560 R3 to that is connected to the level and environmental sensors to get the values of each of them and then send it to the main station through GSM module, at the same time the results will be displayed on LCD in case that the owner was inside the silo and far away from the main station or in case that the main station was disrupted, and want to check the results and due to this also there will be a need of buzzer to alert when a sudden change happens. Fan had heater will be activated when the temperature, humidity and air flow exceeds the fixed value [6].

4. Importance of study

In the last few years Egypt suffers from the wheat corruption issue that causes the country millions of dollars because of the old and very weak techniques used in the current alternative systems, this led to adding or removing a false quantities of wheat. In order to prevent the manipulation in the quantities, the proposed system provides:

- Easy monitoring and controlling grain level and environment inside the silo remotely through using uncomplicated techniques [7].
- Saving a lot of grain quantities from corruption.
- Decreasing manpower to avoid manipulation and fraud [7].
- More accurate data and logs [7].
- Fixing the problem of the time consumption in the technical measurements in the current alternative systems.

This will lead to saving millions of dollars and increase the production of grain quantities.

5. Results

- The system will provide level measurements to prevent the adding or removing of false quantities of grains as shown in the figure [11]:

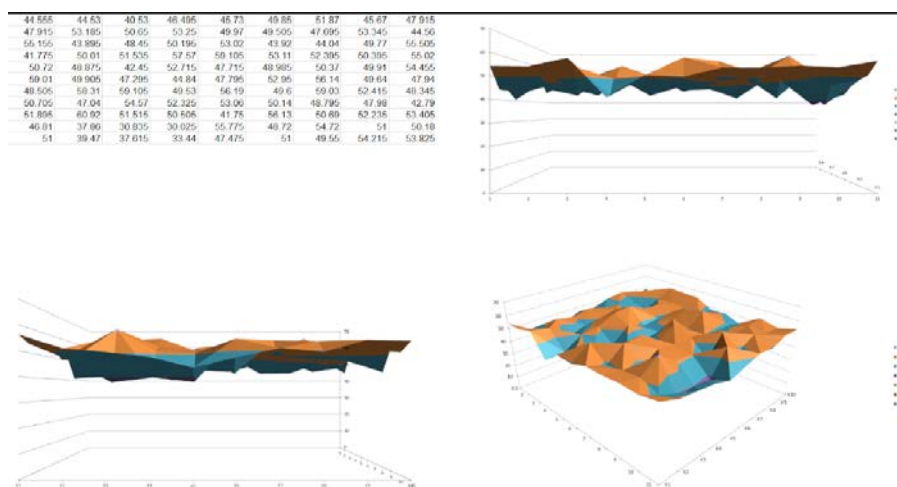


Figure 2: Level measurements

- Providing environmental measurements to monitor the parameters of environment of the storage house as shown in the figure:

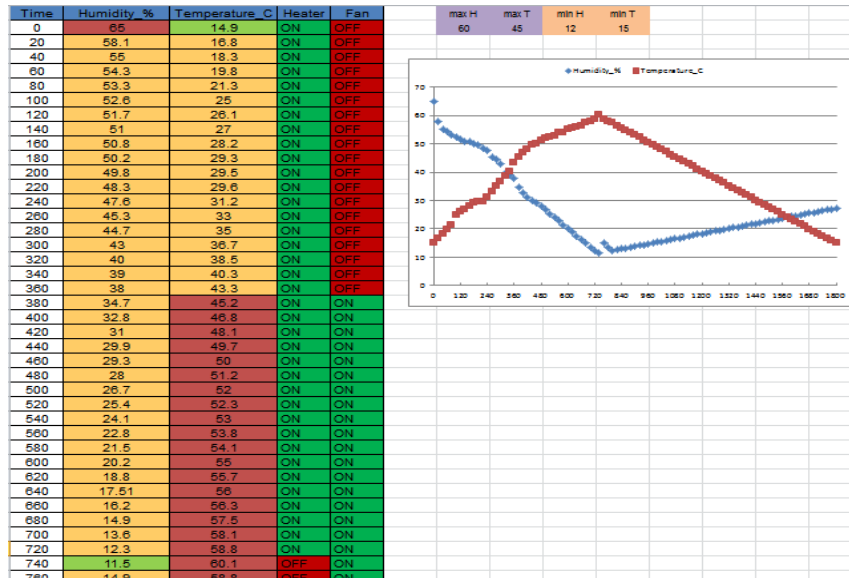


Figure 3: Environmental measurements

6. Limitations of study

However the proposed system designed in a high performance and efficiency through using affordable and applicable techniques such as the ultrasonic sensor attached to the servo motor to measure the largest possible area of the silo and the environmental measurements to measure temperature and humidity, yet the system affected by some of factors:

- The ultrasonic sensor, over the long term, will be affected by dusts. So maintenance is required each period. Using radar is more efficient in this case [8, 9].
- The humidity/temperature sensor may be affected if mounted near to any part that causes changing in temperature such as heater.

7. Recommendations

In order to get a high efficiency while designing the system, the following points should be under consideration:

- The type of level sensor should be depending on the diameter of the silo.
- The environmental sensors should be mounted far away from the parts that may causes changing in temperature.
- For aeration, two fans will be placed on either side of the silo [10].

8. Conclusion

As mentioned before in the definition of the problem that Egypt suffers from serious and huge scandals in the field of wheat that is supposed to be the main source of nourishment of the poor and needy people. The main problem represented in the techniques that used in the wheat storage houses, which is considered to be a very weak and primitive techniques and thus lead to a huge corruption in the wheat field through adding or removing a false quantities of grains, in addition to the Silos environment lacking systems for monitoring and controlling. Due to all the mentioned problems, the proposed system was suggested to be the efficient solution that will end the problems which the current alternative systems suffer from. The system will cover all the problems that is available in the manual and automatic systems. The proposed system will provides level measurements to check the level of the grains continuously through using ultrasonic sensor and we will detect the actual level of the grain inside the storage house. Moreover, the environment will be monitored through environmental sensors to measure the humidity and temperature of the silo[12].If any of the parameters exceeds the predefined value the silo will be controlled through fans and heaters that will be turned on automatically to detect the error and fix it.

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