International Journal of Scientific Advances
ISSN: 2708-7972
Volume: 2 | Issue: 5 | Sep - Oct 2021 Available Online: www.ijscia.com
DOI: 10.51542/ijscia.v2i5.39

Automatic and Manual Filling System

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ABSTRACT
This project aims to develop a filling system with automatic and manual mode, for filling domestic water tanks with an easy-to-use interface for the general public. A filling system was developed with the help of an ultrasonic sensor to measure the water level in the tank. The data obtained will be transferred and processed to the microcontroller of the Arduino program, this information will be represented graphically in the output device (LCD screen). For the control system, 2 buttons have been implemented to activate the automatic and manual modes, with this, it is possible to control the filling level of the water tank. This will allow us to know the advantages and disadvantages which will contribute to the formation of more solid knowledge regarding control systems

Keywords: automatic; sensor; Arduino program

INTRODUCTION
This project shows a practical proposal for an automatic and manual filling system to effectively control the filling and emptying of a tank. At present, it seeks to implement new technologies in the domestic area and at the same time facilitate its use for the general public. Every day we seek to preserve the most valuable resources such as water. That said, efficient management of the aforementioned resource is vital to avoid waste. This is why the need arises to implement a customized system with an easy-to-use interface for filling the water tank and thus reduce waste and have greater control over it.

This obtaining positive results. The system is very useful and will significantly benefit companies, developing businesses, and homes where it is an efficient and effective solution. In automatic and manual filling systems it is important that all the elements that act can offer safety and this at the same time guarantees the complete development of the project. The proposed methodology will be carried out as follows. A filling system will be developed with the help of an ultrasonic sensor to measure the water level in the tank. The data obtained will be transferred and processed to the microcontroller of the Arduino program, this information will be represented graphically in the output device (LCD screen).

For the control system, 2 buttons have been implemented to activate the automatic and manual modes, with this, it is possible to control the filling level of the water tank. This will allow us to know the advantages and disadvantages which will contribute to the formation of more solid knowledge regarding control systems already existing.

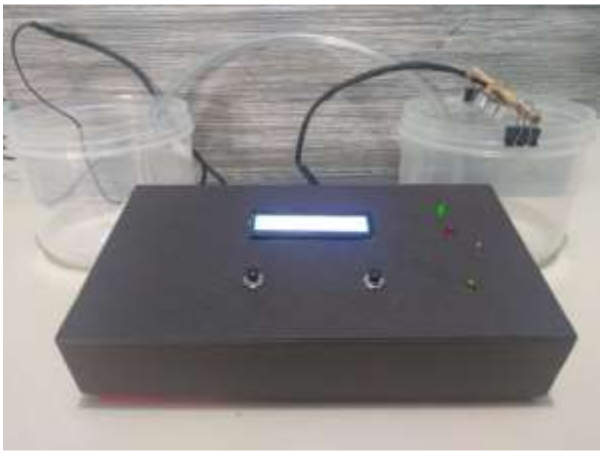

FIGURE 1: System prototype

THEORETICAL FRAMEWORK
Currently the water tank filling system of a house is carried out through a single motor (Pump), driven by an operator. This system implements a direct boot of it. This control system is completely controlled by the operator, the system operator must be aware of the desired water level in the storage tank and this will fill said distributor tank making it an open control circuit.

Water filling systems are indispensable in homes and these are controlled through sensors automatically through a logic programmer controlled or a common electrical control circuit.

The sensors send a signal to the controller so that the pump starts depending on the level that is required in the tank, the most common sensors used to control the filling of a tank are "boya" or float sensors.

Sensor
The sensor provides an analog or digital signal to the controller, which represents the current point where the process or system is located. The signal can represent that value in electrical voltage, electric current intensity, or frequency.

Ultrasonic sensor
The ultrasonic sensor is more practical and does not have to be in contact with water unlike the other systems with which it is being compared. This helps in better data collection.

As the name implies, ultrasonic sensors measure distance by using ultrasonic waves. The head emits an ultrasonic wave and receives the reflected wave returning from the object. Ultrasonic sensors measure the distance to the object by counting the time between emission and reception.

Control systems
It is a system composed of a group of elements that seeks to exert control over other systems. It aims to effectively complete the tasks and assignments for which it was scheduled. To do this, they must behave stably in the face of errors.

GENERAL REQUIREMENTS OF A CONTROL SYSTEM
Stability: Degree of equilibrium that a control system has. With this, the limits during its use in the established period of time are identified, or by the replacement of any of its components when performing any type of maintenance. The response to a signal must reach and maintain useful value for a reasonable period of time, for which the system must have the characteristic of being stable, since an unstable control system could produce, for example, persistent or wide-amplitude oscillations in the signal or that this signal takes values that correspond to the extreme limits, so, from a control point of view, an unstable response is an unwanted option.

Accuracy Extreme: accuracy is not always required in control applications, so it is necessary that there is an error for the system to initiate the corrective action.

There are no control systems that are capable of being maintained without errors. Mathematically you can reduce that error to almost zero, since there will always be imperfections inherent in the components of the system. However, a control system can be accurate within certain limits, where you are able to reduce any errors to a considerable limit.

Speed of response: For a control system to work in the right time frames it must have the characteristic of giving answers quickly. This reaction must be completed at an input signal in an acceptable time. That is, even if the system is stable and presents an accuracy, response time must be carried out quickly.

Water storage
Storage facilities, known as tanks, towers, cisterns or reservoirs, on the one hand, provide storage for treated water prior to distribution for domestic and consumer purposes, and on the other, they balance fluctuations in water quantity and quality. This is done by storing water during times when there is little demand, for example at night, and making sure that there is enough water for the times of greatest demand, when many people need water at the same time. Other uses or functions of water stored in tanks are:

- Complement to other low-yield wells.
- Water supply for emergencies (firefighting, etc.)
- Temporary reserve of treated water when there are punctual interruptions of the supply of the source, failures in the pumping equipment, etc.
- Helps maintain uniform pressure throughout the supply network.

Pumps
Pumps are the elements that provide energy to overcome load losses and the difference in heights between two points. They force the fluid to circulation in a certain direction. Although the fluid can be forced through a pump in the opposite direction, this situation is anomalous. (This clarification has its origin in some of the exams corrected by the authors).

The most commonly used pumps in conventional pumping systems are centrifugal and axial pumps. These pumps can drive a higher flow rate as the resistance or height difference they must overcome decreases.

Ideal deposits
An ideal reservoir is a fluid accumulation element whose height or energy remains constant, allowing to extract or introduce all the fluid you want. Allowing to extract or introduce all the fluid you want, and the concept is not very distant from actual behavior.

Hydropneumatic system
The work of the hydropneumatic system is mainly the distribution of water from local networks at stable pressure. These systems are used to prevent the construction of elevated tanks that provide such pressure adequately. It is a system whose use is both commercial and domestic in terms of supply and distribution. Therefore, the use of the hydropneumatic system ranges from small industries to rural buildings, passing through small shops or private houses. Automatic controls have an increasingly important intervention in everyday life for engineering and science, these dynamic systems provide a basis for solving industrial problems, aircraft piloting systems and even a simple toaster.

Control consists of selecting, from a specific or arbitrary set of elements (or parameters, configurations, functions, etc.), those that, applied to a fixed system, make it behave in a predetermined way.

ELEMENTS OF CONTROL SYSTEMS
The object of an automatic control system is to keep under control (hence they are called controlled variables) one or more outputs of the process. The word process is used in a very general sense, understanding that it is the set of physical phenomena that determine the production of the controlled variables.

From the mathematical point of view, the process will be represented by a set of fundamental relationships, through which the controlled variables are placed in function of two types of independent variables:
(1) Random variables
(2) Manipulated variables

Random variables
Random variables are those variables that escape any control or possibility of manipulation, that is, that adopt values that can vary at random within certain practical limits, constitute disturbances, because once the desired values are obtained in the controlled variables, the tendency is to separate them from them.

Manipulated variables

If only random variables were entered into the process, there would be no degree of control over it and the value of the controlled variables would also be random. To be able to introduce any degree of control, you must have variables on whose values it is possible to operate; hence they are called manipulated variables.

It is precisely these variables that allow the system to be governed, and their essential characteristic is that they can be managed at will within certain limits. The problem of controlling the process consists in eliminating the effects of the disturbances produced by the variation of the random variables, by introducing compensatory variations in the manipulated variables.

Controller The part of the system that synthesizes the manipulated variables is the controller, it contains the necessary program to introduce the variations in the manipulated variables, in order to obtain the desired behavior of the controlled variables. For this, the controller can have different types of information:

(1) Reference
(2) Pre-compensation
(3) Feedback

TECHNICAL INFORMATION

- Arduino
- Leds
- breadboard
- Resisances
- Cable
- Jumpers
- 9v battery connection
- LCD screen
- ultrasonic sensors
- Relay module
- Buzzer
- 2 PushBottons n/a
- 5v pump
- 2 containers of 1Lt
- ¼ in hose

FUNCTIONING

The level control system works with the help of an Arduino UNO and an HC-SR04 ultrasonic sensor. The ultrasonic sensor is more practical and does not have to be in contact with water unlike the other systems with which it is being compared as shown in "table 1" comparison chart, this helps in better data collection. With two modes, AUTOMATIC and MANUAL that are enabled with two PushBottons, these activate a 5-volt pump through a two-channel relay, the first channel controls the automatic and the second enables the manual, in this way both channels control a single pump but each one controls a mode, and the whole process is printed on the LCD screen (with an I2C Adapter). The LCD screen helps to show the best way in which the system is operating. It has been included to show the milliliters discharged, the height of the fluid (WATER) and the state of the tank (EMPTY, LOW, FILLED and FULL) that these states are also reflected in a panel with indicator LEDs. These complement the system so that the operator can easily detect the height of the water in the tank. It is worth mentioning that the manual mode has the restriction that, if the water level reaches the programmed level, the pump will be denied and an alarm (Buzzer) is activated as an indicator of the restriction. This makes the system more complete since there is one more way to detect the water level in the tank.

All connections are represented in the system diagram, this helps to better visualize how the system is composed and helps to better understand its operation.

Prototype design

FIGURE 2: Finished prototype

SYSTEM DIAGRAM

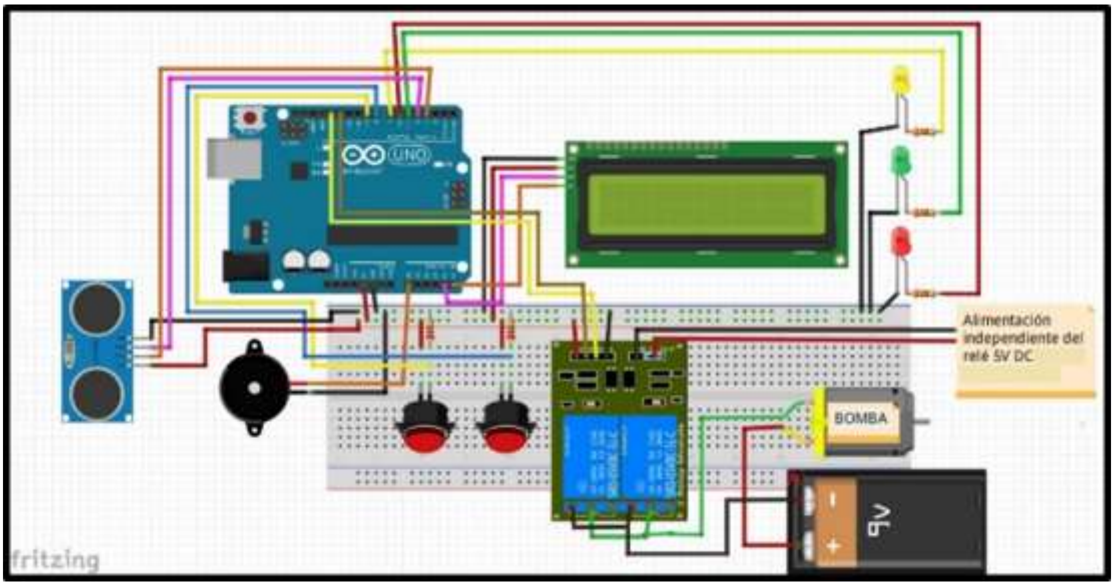

FIGURE 3: Connection diagram of the filling system in Arduino and Protoboard

CONCLUSIONS

At the end of the system and verifying that it met the objectives that were set at the beginning, we were able to realize that if new technologies and innovations are used we can help facilitate the lives of people who are of legal age and cannot be aware of the completion of a tank that is at a high level, just like pregnant women or women who have young children. Carrying out this work motivates us to continue researching and innovating for the support of society in the same way it is know that the cost of an installation and the necessary equipment for such a system at home can be expensive but will not be compared with the benefits to short and the environment, by avoiding the waste of such a vital liquid. It is important to emphasize that by implementing this type of system we would be contributing positively to the use of these programs such as the Arduino and also the sensors, it is sought that other people become passionate and want to help improve many existing home system but that sometimes they cause us more problems and expenses that directly affect the daily the daily economy.

By making this system in a real way, and putting it up for sale, it is expected that it will have a great impact and the goal that more people use new technologies at home can be met, this would give us a completely satisfactory conclusion of the project.

ACKNOWLEDGMENT

The opportunity offered by Langley Conway and IJSCIA greatly supports the development, creation and imagination of many researchers and in our case of students and professors dedicated to the innovation of projects that help or facilitate the lives of human beings. We are grateful for the opportunity to publish and motivate further researching content of interest.

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TABLE 1: Comparative Chart of Filling Systems

System	Design	Advantage	Disadvantages
Automatic-manual filling system		• Shows the percentage of the water level • It has an automatic and manual system • Can fill tank to specific levels • It has led indicators that show the working status of the system and the working status of the pump • It has an audible alarm that indicates the status of the water level	• Maintenance required • Only shows the water level with percentage
Electric float for water tank		• Use in water tanks and tanks • Easy to install • Does not consume energy • It has no mechanical parts	• Does not indicate specific water level • You cannot fill the tank to specific levels • Does not warn when the tank is full • It is totally analogous
Pump control		• Starts and stops the pump automatically • It has led indicators to observe the tank levels • Protects the pump from electric shock.	• Only works with liquids of medium electrical conductivity • You cannot fill the tank to specific levels • Requires three sensors that go underwater • Requires more maintenance