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Design of an Irrigation System using a Motor Pump for Desert Areas in Department of Piura - Perú

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***Abstract*— Currently the world suffers from water scarcity, being one of the most frequent problems that agriculture suffers, there is still no uniformity regarding the extent of the planet covered by these dry lands, varying the calculations from close to 50% to 25% of the earth's surface. Africa and Asia being the continents that had the largest extensions of drylands. Therefore, this research work has as objective the Design of an Irrigation System using a Motor Pump for Desert Areas in Department of Piura - Perú and thus contribute to the agriculture of our country, as well as main points we will focus on the towns far from the city which will use automatic irrigation means through a natural reserve water supply which would have to be stored and through a drip system it will be possible to irrigate and optimize the water in order to give it a better use. Resulting in a water reservoir that once filled to 100% will begin to pump water through a motor pump and through pipes it will be transferred to another reserve reservoir to irrigate a desert area through a drip system so the reservoir plays an important role which will have available water without depleting given greater access to irrigate the land.**

***Keywords*— Agriculture; deserted zones; automatic watering; Drip system; Motor pump**

I. INTRODUCTION

Over the years [1], technology advances by leaps and bounds and this has led to the fact that traditional agricultural practices for food production are not very efficient, being replaced by crops in greenhouses or also known as controlled environment agriculture that usually hydroponics techniques are also added. Green Revolution is the pattern of agricultural production systems and therefore of the livestock sector was transformed. The modernity of the green revolution has been proposed as a model system for soils with salt problems, where conventional agriculture cannot be adequately developed, so it is of interest to study and develop it as a crop with prospects for commercial exploitation [2].

Worldwide, crop diversification is a planning objective, since there is a need to intensify efforts to increase the rational use of renewable natural resources through comprehensive programs. [3] In this sense, some areas have a variety of plant species, of which some develop in deserts and coastal systems, plants that in the process of evolution to survive an arid-saline environment have developed unique properties, many of which are of important economic interest and can be exploited in the short term in agribusiness.

There is still no uniformity regarding the extent of the planet covered by these drylands, [4] varying estimates from about 50% to 25% of the earth's surface. According to UNEP data, drylands reached a total of 6.150 million hectares (61.5 million km^2), with Africa and Asia being the continents with the largest extensions (32% each one, regarding to the total). The United Nations Environment Program indicates that the degraded surface in the world is equivalent to 30% of the planet's land surface and affects more than one billion people. Soil is lost at an annual rate of 24 billion tons, and the annual costs of global desertification are estimated at between 40 and 45 billion dollars, which does not include the social costs involved.

Agriculture constitutes one of the economic activities with the greatest productive potential for the Piura region, both due to the natural weather conditions and the availability of resources: 500 thousand hectares with agricultural aptitude (According to information from the study of Ecological Economic Zoning that has just completed the Regional Government) of which approximately 200 thousand are already cultivated and more or less 170 thousand of them, mainly on the coast, have an important network of canal infrastructure that makes it possible to apply permanent regulated irrigation [5].

Despite the fact that the entire agricultural area has not yet been used, agriculture plays an important role in the regional economy, maintaining its condition of being the source of employment for 30.1% of the economically active population, for the economic dynamism generated by traditional crops such as cotton, rice, corn and coffee; and the export boom in recent years generated by non-traditional such as bananas, mangoes, cocoa, beans, among others; many of which, classified under the heading of ecological or organic, have conquered important market niches that are being used by small producers [5].

Therefore, the main objective of this project is to irrigate the desert areas of the Piura region and thus be able to continue contributing to the agricultural agriculture of our country as main points we will focus on the towns far from the city which will use irrigation means automatic by means of a natural reserve water supply which would have to be stored and through a drip system, it will be possible to irrigate and optimize the water in order to give it a better use.

The motor pump is a machine that transforms energy, applying this energy can move the water, normally it is in an upward movement. There are two types of pumps: "volumetric" and "turbo-pump". This pump receives its energy through a coupled motor which can be (electric, diesel or gasoline), in this case the gasoline one will be used since it will be used far from the city and there is no electricity. Its operation of this water pump is very simple since the water is sucked in through the inlet tube and then driven by a motor which will be used as a means of transport to where it will be redirected through pipes or drip sleeves.

The drip irrigation system, better known as "drip irrigation," is a method of irrigation used in arid areas, as it allows the optimization of water, this drip irrigation system consists of watering the plant through drops which are filtered by a hose or PVC tube which allows the water to reach further and make it reach much more.

The drip irrigation system a motor pump which will work through a network of pipes (conduction and distribution of PVC or polyethylene), irrigation sides (hoses or tapes), with emitters or drippers, with technical designs that deliver small volumes of water periodically, depending on the requirements of the crop or the soil holding capacity.

In section II, the methodology will be presented where the operation and use of the system, application and use for the irrigation of the valley or place will be discussed.

In section III, the results will be shown identifying the results obtained. In section IV, discussions of the research paper will be presented. In section V, the conclusions of the research work.

II. Literature Review

In [6], the irrigation system with 2 irrigations per day to a hydroponic crop with 16 plants for a week (7 days), the water resource expenditure was 3.36 liters or 0.88 gallons, this practice was also done manually to a crop in traditional soil, 0.14 liters per plant was spent on each irrigation, which in total was 2.24 liters per irrigation and in a week the water consumption was 31.36 liters or 8.28 gallons.

Being able to conclude with the presentation of the project, it was possible to observe the liking of the people and the interest, the question they asked the most was if it could be adapted to any crop and the answer is yes, with small modifications the system can be adapted without problems

In [7], it is proposed to generate changes in greenhouse systems to demonstrate that technology and agronomy can work together to achieve a quality export product, reducing product costs. Regarding the project, they were able to design and implement their prototype to scale and thus achieve the expected functionality. These objectives are focused on improving the productive capacities in the agricultural sector, since, by achieving control over the essential variables for the growth of a crop, we will improve the quality of the product and the production of this will be in a shorter period and thus obtain a design and software capable of reducing environmental impact.

They managed to identify the great potential that this project has after a series of previous research works which allowed them to start developing it to achieve the specified objective.

In [8], the reconversion of crops in exchange for a product or activity that represents greater economic profitability and social viability for the agricultural producer is defined, and thus being able to recover degraded soils, such as the recovery of abandoned areas by traditional agriculture, mainly in coastal areas. An important agro-industrial derivative of Salicornia is the obtaining of fatty acids with a high percentage of unsaturated linoleic acid (74%). Currently worldwide, the Salicornia producing areas are aimed at exporting to various European countries, such as France, Spain, Holland and England, its main purpose being food use and the extraction and production of oils.

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As a result of the project, they were able to conclude that in arid-desert areas, where 70% of agricultural food is produced worldwide, among the adverse factors of an abiotic type, salinity stands out, which is it worsens as time passes, reducing the production of conventional crops [8].

Water on the Peruvian coast has always been scarce, of the 53 rivers that run from Tumbes to Tacna, 80% of them are irregular and only 20% can be used all year round. For this reason, the water resource is constituted as the "limiting factor of the first order" in agricultural production. This situation forces every farmer, user and / or producer to manage irrigation water, with great rationality and efficiency [9].

In recent years, drip irrigation projects have been carried out significantly, this being intermittent, which is widely used to ensure the growth of crops in arid regions, being used more often to improve soils and support agriculture in order to to design a reasonable field irrigation plan [10].

The catchment or location is the main point where a water supply system starts, its function being to catch it for the supply of a community. Since it can be one or more sources, the important thing is that it meets the demand that the community needs [11].

It is an interval that must be considered in the design of water systems to calculate the conduction line. The main function of this pipeline is to direct the water starting at the catchment to a sector where it will be distributed.

III. Methodology

In this section, the process of identifying the water is developed, where the reservoir is located, then the identification of the water level and after this an alarm is activated, this alarm will indicate where the water level is and therefore it is activated for operation and the motor pump can be turned on, as shown in Figure 1.

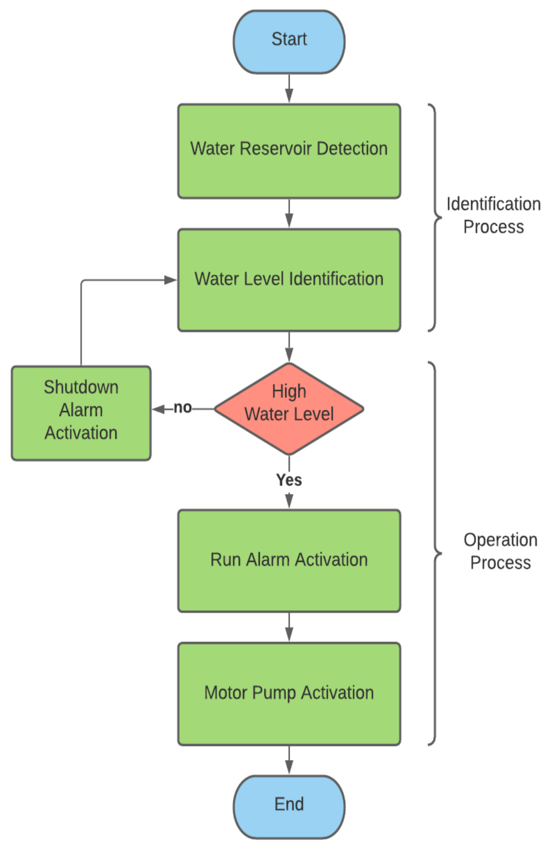

Fig. 1. Flow chart Irrigation system in desert areas

After the diagram, it will begin to explain in more detail each of the processes that is required for the operation of the system.

A. Identification process

In this process, two threads can be identified, which will be seen in more detail below:

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- At this point the best location and construction of the water reservoir is defined, where and how the reservoir will be built as shown in the following Figure 2.

Fig. 2. Reserorio Construction

- Once the reservoir is built, the drip system will begin to be implemented to irrigate the arid area and where water cannot reach, once the construction of the reservoir is completed, we will explain its functionality at each point.
- Water level identification: At this point the water level identification can be carried out through a sensor which will be commanded and monitored through a controller as seen in Figure 3.

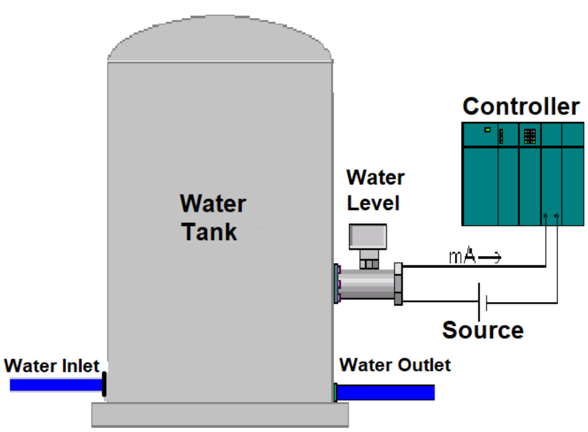

Fig. 3. Water identifier and controller

- Which will be configured to be able to remotely control through text messages and only in case the sensor presents a fault only there will a person appear to identify the problem. The possible serious problems that the activation alarm does not activate and is turned off only a person will physically approach the water reservoir.
- Failure detection and diagnosis system, this section presents the implementation of the real-time failure detection system, based on OGL, for the DAC 603 tank system, which is the fundamental result of this work, as part of the first phase of development of a supervision system adjusted to the ISA101 standard. First, the specifications of the industrial process at the DAC 603 scale are given, as well as the available instrumentation. Then, the implementation architecture based on ISA101 is presented, and finally the OGL design and its implementation using the HMI interface in the industry are displays, operator terminals and SCADA systems. The ISA101 HMI technical reports are intended to help understand the human-machine interface recommended by the standard.
- The standard defines the terminology and development models for an HMI and recommended work processes to effectively maintain throughout its life cycle. The standard is intended to provide guidance for designing, building, operating, and maintaining effective HMIs that are safer, more effective, and more efficient in controlling a process, under all operating conditions.
- The DAC 603 is a piece of equipment available in the Control Systems Laboratory that allows basic training in instrument calibration and control loops, where subsystems with temperature, flow, pressure and level2 control loops stand out.
- The process begins with the supply of flow (water) to tank 1, see Fig. 2. By means of a 6.5 HP motor pump (motor pump 1) at a speed of 11n.m / 2500 RPM, while through the Valves V-1 and V-2 perform the interconnection with tank 1, that is, liquid is extracted from tank 1 allowing tank 2 to be filled. Then through the manual valve V-1 the water is extracted from tank 2 respectively, and they are measured through differential pressure transmitters, which generate an electrical signal between 4-2mA, corresponding to the height of the liquid in the tank. In this way, the process considered for the control and diagnosis of failures

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Fig. 4. Gasoline Motor Pump KL-715

In Fig. 4. We can see the KL-715 Gasoline Motor Pump which I will give more detail of its characteristics and price.

Table 1
Motor pump characteristics

Brand	Kaili
Model	KL-715
Discharge time	50 m3/h
Suction and discharge diameter	80 mm (3´´)
Power	6.5HP
Maximum head (pump)	28 mm
Maximum suction (pump)	7 m
Power (motor)	6.5HP
Displacement volume (motor)	196 cc
Compression ratio (motor)	8.5:1
Maximum torque (engine)	11n.m/2500 rpm
Fuel volume (engine)	3.6
Oil volume (engine)	0.6
Usage	Water pump
Price	S/ PEN 1,139

- There could also be an obstruction at the outlet where the reservoir begins to pump the water, due to a collapse of some other type.

B. Operating Process.

In the operating process, it will be possible to identify and define well the necessary requirements so that the irrigation system can function, which will be formed as follows, starting with the water level, then the activation of the operation alarm and finally the activation of the motor pump, in Figure 4. The reader can see the water level detection.

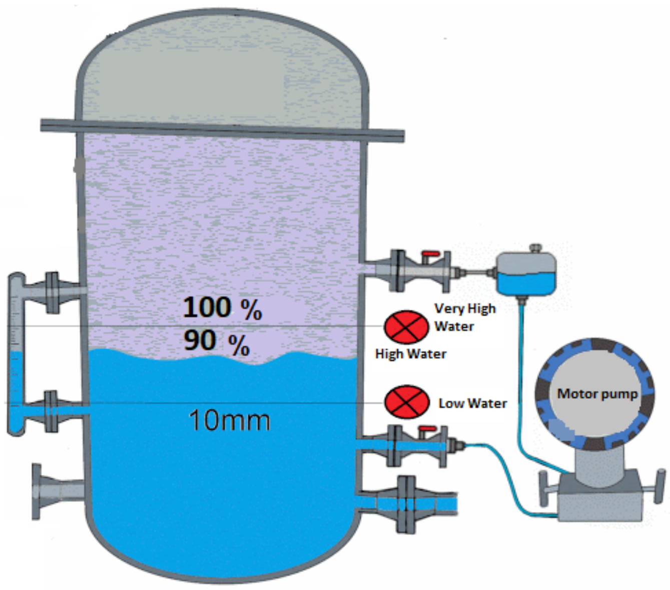

Fig. 5. Identifying Water Level

As we can visualize the image, there are sensors which alert us to the low and high-water level of the reservoir. This means that if the water level is below 10 mm, the alarm will be activated and send an alert message and so that the motor of the pump turns off so that the water level does not reach its limit and finally turn off the alarm.

After the water is at 90%, the alarm will send a message indicating that the reservoir is almost full, which will show a high-water level message, and it will be possible to use and start the motor of the pump if the operator is desire it. If the operator does not realize it and does not turn on the motor pump, the water will continue to rise until it reaches 100% where the alarm will show an alert message showing the water level too high, this will cause the motor pump turns on automatically and starts irrigating automatically to avoid water bouncing.

The motor has two windings, it is built in such a way that it is two independent motors wound on the same stator, one or the other winding is energized to obtain the speeds.

One winding 2 connections, two speed single winding motors have a so called "consequent pole" design. These motors are wound for a single speed, but when the winding is reconnected, the number of magnetic poles in the stator is doubled.

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IV. RESULTS

In Figure 5, the control and operation of the motor pump is shown, which starts to work automatically after reaching 100% and thus prevents the reservoir from bouncing off water.

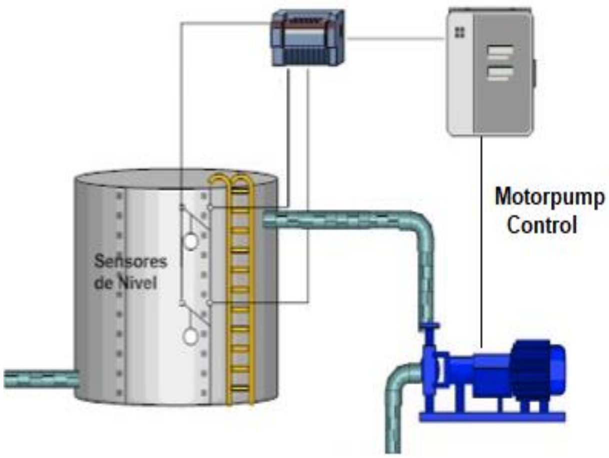

Fig. 6. Motor Pump Control and Operation

The motor pump fulfills the function of pumping the water through pipes as well as another reservoir of pipes which will be active for most of the day, thus being the perennial irrigated and preventing the water from running out, as seen in Figure 7.

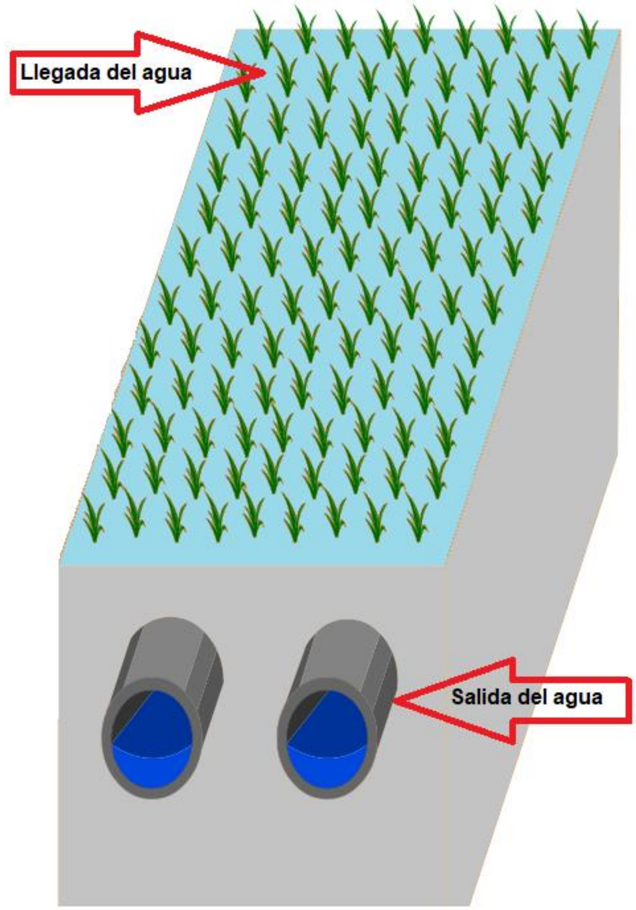

Fig. 7. External Water Reservoir

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Table 2
Results of the Drip Irrigation System

Advantages	Disadvantages
• Water savings compared to traditional systems • Adapts to all types of surfaces • Increase in the quantity and quality of crops. • Less labor. • Fertigation. • Exact water arrangement • Reduction of pest problems • Reduction of weeds	• Costly implementation. • Complexity of the facilities. • Plugging of drippers. • Contamination of the soil with salts.

The electric floats are used to control the water level in elevated tanks (water tanks) or cisterns, they order to stop or start the motor of the motor pump, this is possible to an internal ball (steel pellet), which operates a lever that changes the contacts of a micro-switch (microswitch) according to the float altitude. The electrical characteristics are 127 volts ~, 60 Hz, 10 Ampere, the electric floats have a 100% hermetic polypropylene body allowing it to float thanks to its flexible cable (with 3 conductors) it can change altitude, adjusting its displacement by means of a counterweight.

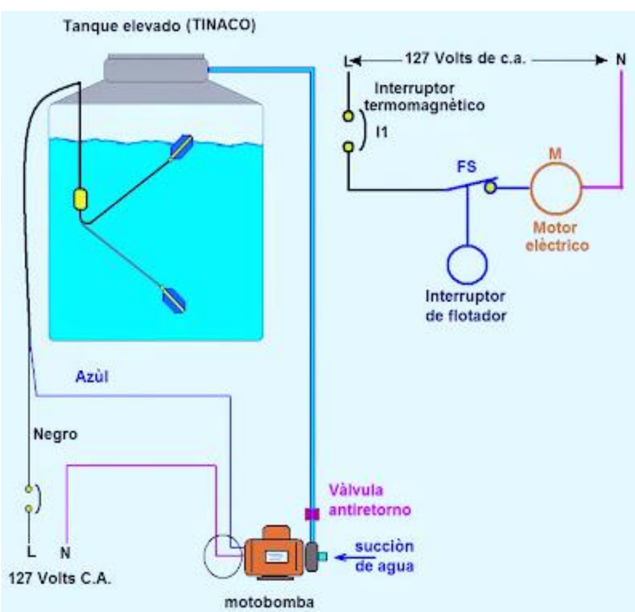

Fig. 8. Tank Pump Connection

If the float is down, the weight of the pellet will activate the microswitch and the NO (Normally Open) contact will close.

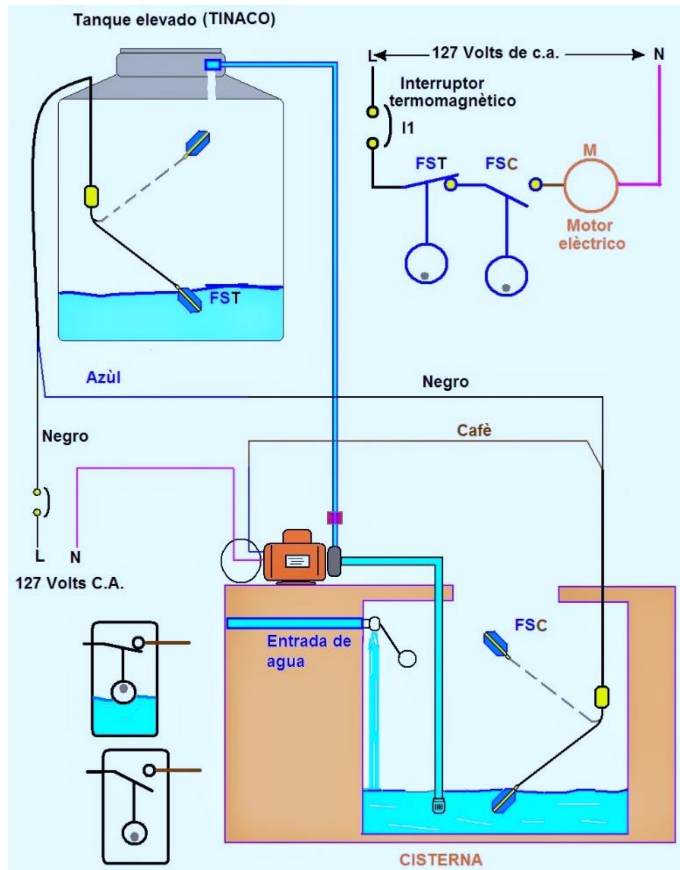

Fig. 9. Cistern Tank Pump Connection

In fig. 9, it can be observed that the tank is empty and only then the engine will work only if there is insufficient water in the tank then the engine will start.

V. Discussion

In this research work, it was possible to identify that a pumping system has enough power to irrigate more than 2 hectares depending on the motor pump in the same way in [12], the motor pump is a machine that transforms energy, applying this energy, this motor can move water, normally without any difficulty, being able to irrigate arid-desert areas, where 70% of agricultural food is produced worldwide.

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Taking into account that water is very essential and useful to irrigate, with our irrigation system, it can save water and energy by using the motor pump to fill another reservoir which will be as a reserve and the water is permanent, being able to save and irrigate more crops that In [6], the irrigation system with 2 irrigations per day to a hydroponic culture with 16 plants during a week (7 days) the water resource expenditure was 3.36 liters or 0.88 gallons, this practice was also done manually at a cultivation in traditional soil, in each irrigation 0.14 liters per plant was spent, which in total was 2.24 liters per irrigation and in the week the water consumption was 31.36 liters or 8.28 gallons.

In the same way, in the research work, it can be observed that the system is assigned to irrigate in the Piura region area where the terrain and climate are suitable to sow any type of seed or plant and not limit ourselves to just one product as is done in the [13] which uses its drip irrigation system only for fruit, citrus, vine and horticultural crops, especially in temperate zones with scarce water resources.

In the same way, it was possible to save energy and reduce labor compared to [14] that uses an area of drippers that are closed and needs more constant maintenance due to the water load that is generated.

VI. Conclusions

We can conclude that the motor pump fulfills the function of pumping the water through pipes as well as another reservoir of pipes which will be active most of the day, thus being the perennial irrigated and preventing the water from running out and always being active.

In this way, it can also be observed that once the reservoir is 90% full, the alarm will send a message indicating that it is almost full, which will show a high-water level message, and it will be possible to use and start the motor of the motor pump. If the operator so wishes, on the contrary, if the operator does not realize it and does not turn on the motor pump, the water will continue to increase until it reaches 100% where the alarm will show an alert message showing the very high-water level, this will make the motor pump turn on automatically and start to irrigate automatically to avoid rebounding water, thus having the land always irrigated.

In the same way, the additional reservoir plays an important role in this project, making water always available and without depleting, giving greater access to irrigate the land.

Seeing the results, we have many advantages, highlighting among them the saving of water and the reduction of labor since it allows us to carry out automatic watering and the saving of money to invest in its own maintenance and thus it is always active.

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