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# DESIGNING A MULTIPURPOSE EDR201A05 BASED HIGHLY ELECTRICAL ENERGY EFFICIENT AUTOMATIC IRRIGATOR SYSTEM PROVIDING CONTINUOUS CROP NOURISHING AND OPTIMAL UTILIZATION OF WATER RESOURCES

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## ABSTRACT

Automatic water pumping system is extremely required for effective usage of water resources in various areas such as irrigation for crops. In this paper, an Automatic Irrigator (AI) system which can save water wastage by controlled water pumping thus provides very high energy efficiency is presented. The system has its ability to automatically control the turning on and off of the motor, based on the water level, thus maintaining a controlled water level. The stunning feature of this system can be to provide solutions for the varying water requirements of the crops at different stages during the growth process by considering a micro-controller based approach to automatically maintain the varying levels of waters as per requirements. Also several other applications of this proposed system exists such as water level control in water tanks, maintaining ground water level, etc., thus usable for multiple applications, by making slight modifications to the system. The proposed system based on EDR201A05 makes use of only a single 5V DC supply to control, based on the conductive property of water, a motor which can pump water. The proposed system is also extremely attractive because of its simplicity, controllability, and low cost. This system can also automatically sends the pumping motors into idle state during rainy days saving power and water.

**Keywords:** *AI, Controlled water pumping, EDR201A05, Automatic water pumping system, Data Acquisition device myDAQ, LabVIEW*

## 1. INTRODUCTION

It is a well-known fact that all crops require water to grow and produce yields. Water requirements of crops are different at different stages of their growth. If that varying requirement is strictly met, optimal irrigation can be achieved. A graph indicating the water (i.e. water level) requirements for a tomato crop, at various stages during its growth period, is shown in Figure 5. Our proposed system is extremely essential mechanism for automatic irrigation as it provides only the accurate water requirement for the crop. This saves electrical, water resources and human monitoring at the best possible level. Automatic irrigators are products and processes used to collect information about the amount of water that should be applied to the farming field to meet the water requirements of the crops. The evaluation of the potential of space-borne bi-static interferometric synthetic aperture radar images used for the monitoring biophysical variables in wetlands is implemented in [1], which has the drawback of using sophisticated machinery, where a special interest is shown on paddy rice. Our proposed system is proved to be simple. A development and implementation of an efficient and simple photovoltaic water pumping system is presented in [2], where saving water resource is not given priority. Our proposed system is proved to save water to the best possible way. An approach based on correlation, estimating crop yield, applied to three small counties, and three main crops (paddy rice, corn, and winter wheat) in these areas is analyzed in [3] which provides the details about

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crops and its requirements. A new power system using renewable energy which is suitable for small islands is proposed in [4] which can be used as improvements in terms of energy and control. A description of a hybrid system with detailed simulation results which supports its feasibility is given in [5], which has the drawback of only the maximum power considerations. Impact of prices of electricity on energy and groundwater demand management is shown in [6], which gives the importance of water and electrical resources. The farmers being quite rational in their decisions given the problematic context of making choices is presented in [7], exposing the requirements of the farmers. Principal sources of electrical energy being exploited are shown in [8], gives the estimation of the amount of electrical energy that can be generated and thus indicates the necessity of accurate power consumption. Our system calculates the estimated electrical energy and water required by a crop during its entire growth period. Electricity for irrigation pump-sets and its importance is highlighted in [9], giving the necessity for accurate and efficient electricity usage. It is found that from sustainability point of view, the smallest net size will have the most competitive size for farm fields, as for knowledge-based enterprises is concerned[10], which can be considered as one of the parameter of requirement that a crop has. A microcontroller based automatic irrigation system model of variable rate is presented in [11], to which our system additionally includes crop safety and the corresponding automatic motor control. A microcontroller-based water quantity controller algorithm was proposed considering threshold values of soil moisture and temperature in [12], where electrical efficiency is not given priority. Graph for rice crop water requirements at various stages is shown in Figure 7. [13].

In this paper, a multi-purpose, automatic Irrigator (AI) system is presented. The Irrigation controller device gathers the data of the level of water required and uses it to control the switching state of the motor whenever there is a sudden change in water level above or below a pre-determined value. The information of level of the water to be maintained depends upon the type of crops grown in the area where this proposed system is to be implemented. The entire operation of change of switching happens automatically and within less than a second and thus nearly ideal irrigation is maintained. This proposed system can be implemented in various models such as using an overhead tank, direct pumping from bore wells, ground water level controller, continuous nourishing of flower plants implemented in pots, etc. This proposed system is proved to eliminate the need for human intervention saving labor, time and water wastage. There is no need of using any sophisticated devices such as microcontrollers, interfacing, etc. to act as the brain of the system and thus the system is proved to be simple and extremely cost efficient as only the conductive behavioral property of water is used as the controlling master-mind. A brief introduction of details of this proposed system oriented in highlighting its merits is given in Section 2. In Section 3 a sample application of this system which proves its efficiency is provided. The practical applications of the overall system are for saving water, especially during rainy days, providing best usage of water resources, saving manual monitoring, interferences and efforts. Also it can be considered for a wide range of applications where proper water resources utilization is of highest priority and frequent water supply monitoring is not possible. Conclusion is presented in Section 4.

## 2. PROBLEM FORMULATION

One of the main challenges of an Automatic Irrigator System is to find out the exact quantity of water that should be supplied to the farm field, to meet the water requirements of the crops growing in it, as too much of watering leads to wastage of water which is highly valued in countries having little or no rain. Also it can cause the ground water level to raise leading to unfavorable saturation of the root zone. Even too little watering makes the plants to become limp. This may be different for different crops. Rainfall is always a very important source of water for farming. Another challenge is to make efficient use of rain water and thus should provide artificial means of watering, only when there are no rains, to guarantee a good yield with efficient utilization of water resources. Third important challenge is that it should be taken care that too much of watering is not supplied, as it may kill the crops. Also the problem of two much flooding of watering during heavy rains needs to be solved. Periods with insufficient water supply if prolonged may cause crop failure. In addition, the requirements of watering should be clear for designing an efficient irrigation system and scheduling irrigation.

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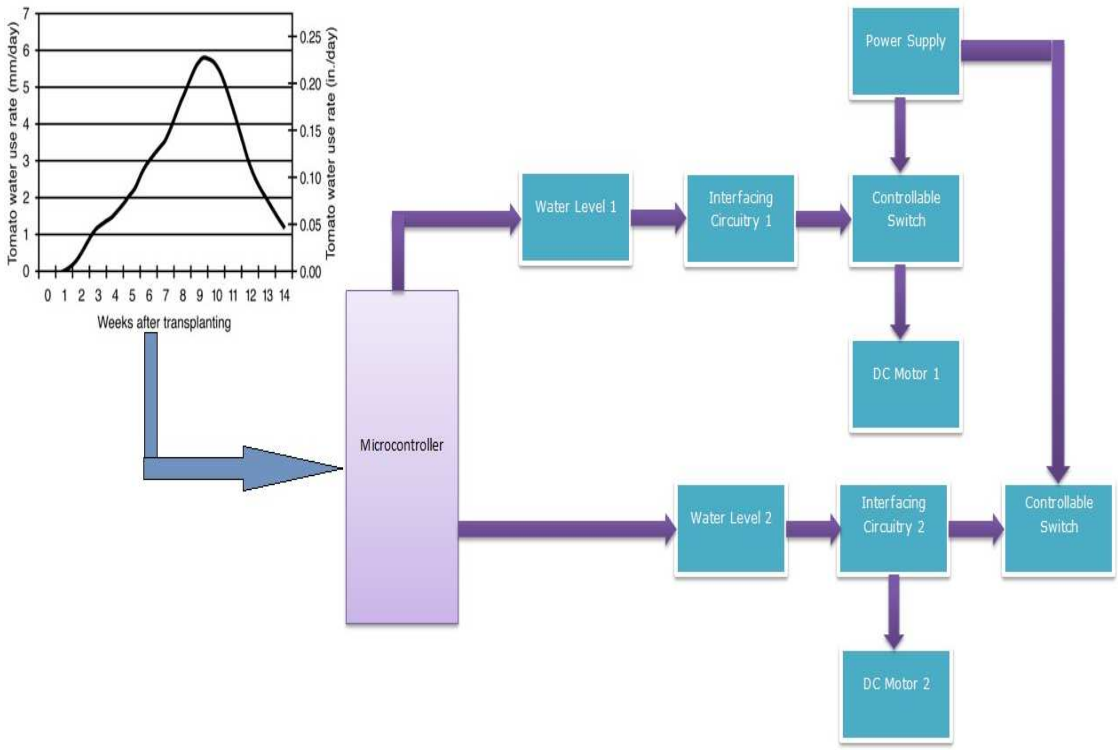


*Figure 1: Block diagram of the Automatic Irrigator System.*

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## 3. PROBLEM SOLUTIONS

My proposed system meets all the above mentioned challenges. This proposed system also provides continuous nourishing for crops and saves water wastage by controlling the water pumping so that it is done only under essential circumstances, simultaneously saving the power consumption for pumping water as unnecessary pumping is avoided and thus it is proved that this system provides very high efficiency. The current existing system does not meet the complete modulating requirements of crop simultaneously saving several mentioned resources.

If the proposed system in this paper was not used, and irrigation was to be done then there would be wastage of electricity and water resources at a very high amount. As my proposed system doesn't include complicated controlling circuitry, it is proved that the overall cost of the implementation of this system is very low. The fact that only a small number of components are used in this system proves the simplicity of this system. The main challenge of an AI is that it should support the real time data transfer i.e., that the rates of data transfer should be within a suitable range. Since the components used shown in Figure 2 all respond within seconds it is also proved that this system operates at real time. This proposed system is easily compatible for any irrigation system and conditions. There are several methods of controlled water pumping in Automatic Irrigator systems. One method is maintaining a fixed level of water by using a mechanism of controlling a single motor which pumps water (into the field) when water level is low and stops once the specified level is reached. This type of Automatic Irrigation is suitable for the cases where there is no or sufficiently low rainfall. A smart modification to the previously described system is used to save the crops during rainy days.

This modification is the pumping of water in the reverse direction (out of the field) so that the crop doesn't die of excessive watering. A third model with both motors is shown in Figure 1 where motor 1 is used to pump water into the field and motor 2 is used to pump out of the field. This model is suitable in all conditions and thus can be efficiently implemented as stated earlier. But it has the overhead of using two motors but this drawback is negligible compared to the amount of good this system does. Figure 2 and Figure 3, the results of simulation in Multisim, shows the Automatic

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Irrigator system not sensing and sensing the water levels respectively, which can be used to control the ON condition of the motor.

*Table 1: Conditions of water level and Corresponding Motor Running Status*

| S.No | Water level | Motor Status | Approxi--mate Time |
|---|---|---|---|
| 1. | High | ON (to pump out, for example, water during floods) | 0.18 S |
| 2. | Low | OFF | 0.7 S |

The 169k resistor shown is the resistance of water. The 1.382nV shown in Figure 2 indicates that the motor is in off condition as the power supply given to it is nearly 0V, when the water level is low (169k unconnected), i.e., below a predetermined level. The 229.924V shown in Figure 3 indicates that the motor is in on condition as the power supply given to it is nearly 230V, when the water level is high (169k connected), i.e., above a predetermined level. This is shown in Table 1. The 169k resistance of water can be obtained by using a multi-meter as shown in Figure 4. Different values can be obtained based on different conditions.

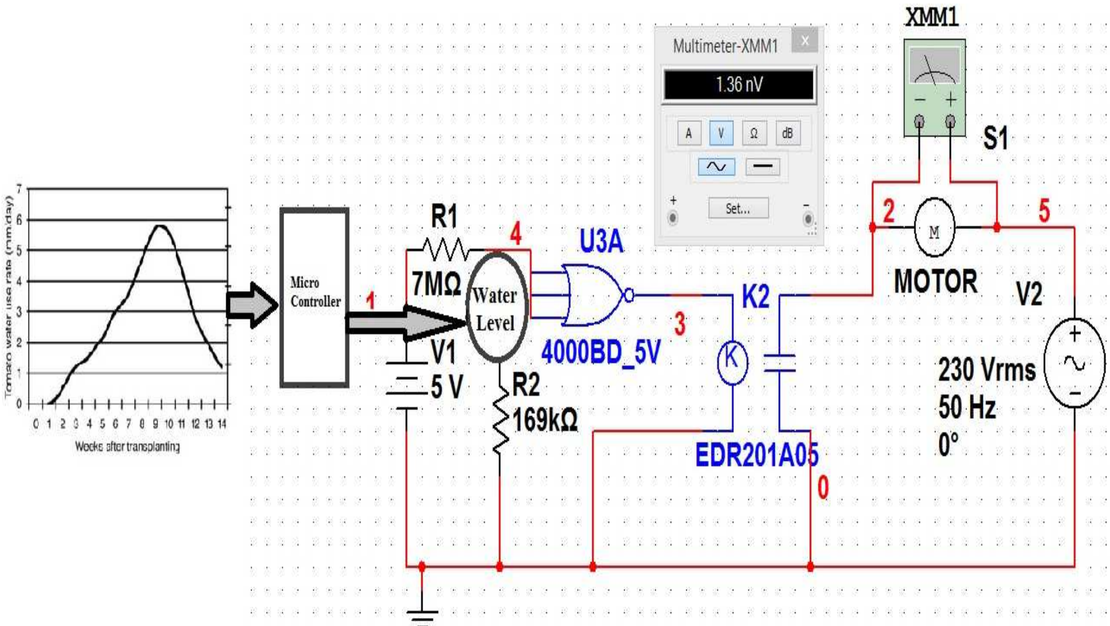


*Figure 2: Snap shot of simulation result corresponding to low water level*

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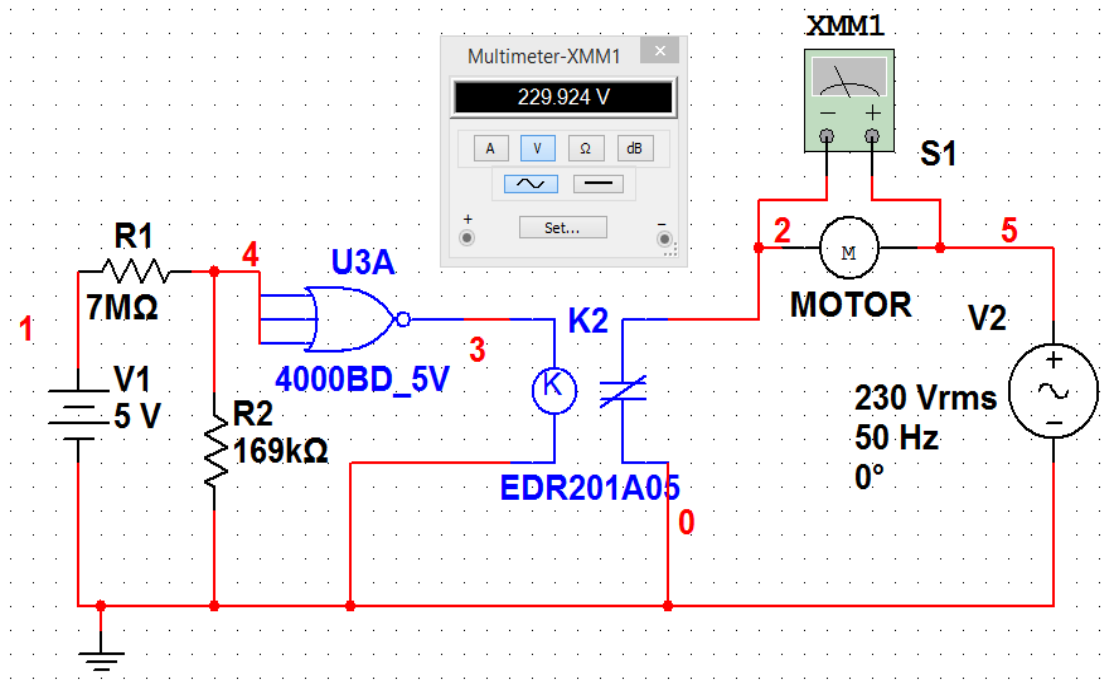


*Figure 3: Snap shot of simulation result corresponding to high water level.*

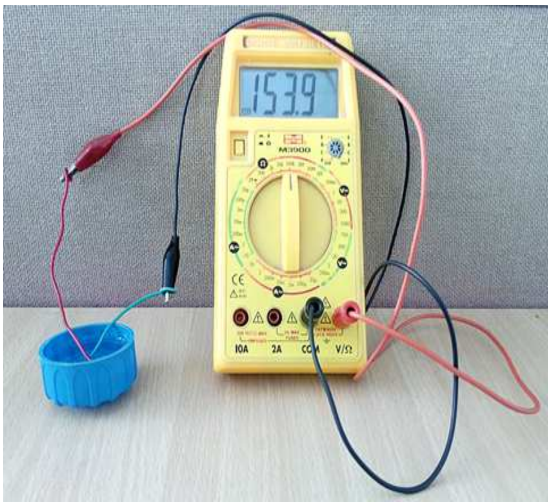


*Figure 4: Measurement of resistance of water.*

The special arrangement made, as described in Figure 2 and Figure 3 can be used to pump out water from the farming fields during heavy rains, so as to save the crops. The varying water level requirements for tomato crop are shown in Figure 5[14].

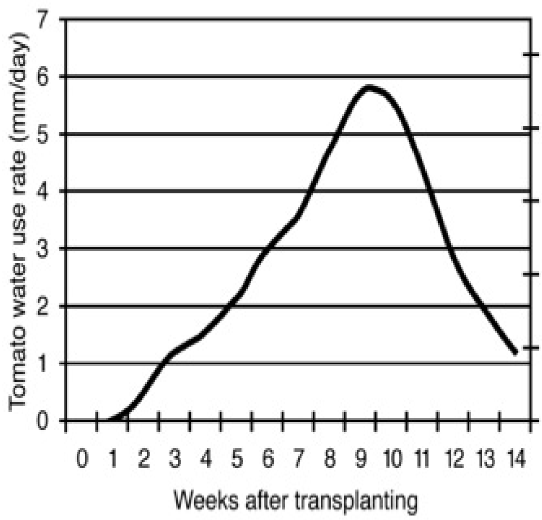


*Figure 5: Varying water level requirements for Tomato.*

Several combinations and modifications can be made to my proposed to system based on application. My proposed systems are essential to maintain healthy and beautiful crops as shown in Figure 6.

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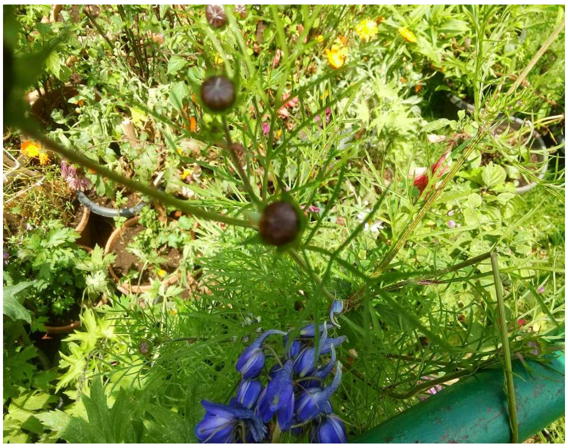

*Figure 6: Sample result of the implemented system.*

## 4. CONCLUSION

In this work an automatic irrigator system, which is proved to primarily provide safeties for crops during floods is provided. The main stunning feature of this system is that it provided accurate and required modulating water supply saving every resource to the best effect. Another stunning feature of this system is that it automatically sends the motor into ON state during floods to pump out water to keep the crops safe. Another fantastic feature of this system is that it also automatically turns the motors OFF, when the rains are providing sufficient water for the crops and, even when there are no rains. The third magnificent feature of this system is that it can be modified based on applications, for example to pump water during drought conditions and complete automation and control can be obtained if two motors are used. This is proved to provide a tremendous amount of savings in electrical energy, water resources and man power, which are having very high values at all times. The system also gives its users a wide range of options, in terms of the maintenance of crops. This or a certain modification of this system can be used to solve an infinite number of irrigation problems based on applications. Thus there is always this cool advantage of not having an additional necessity of any maintenance costs relating irrigation. As per the aspect of simplicity of this system, use of bulky control systems and power supply requirement thereof is avoided as the system is smartly balanced with simple elements and is therefore least costly. Thus it is proved that this system provides the best possible improvements in terms of costs, safety, and simplicity.

## 5. IMPLIMENTATION DETAILS

In the implemented system shown in Figure 8, a Laptop having LabVIEW, with myDAQ connected, is used as the master controller to provide the exact amount of water required by the crop, based on the data provided by the graph shown in Figure 5. Stepper motor is used to provide and maintain the desired level of water by simply modulating the level of water sensing rod via a pulley, by its rotations. myDAQ is used to send the data required to control the rotations of stepper motor. Thus water level modulation, where the message signal is the graph in Figure 5, is achieved. When this modulating water level is reached, that signal is given to the EDR201A05 which controls the ON state of the water supplying motor supplying the water. A small sample plant is used for prototyping this work.

## 6. FUTURE SCOPE

In addition to this system, a complete interface of the agricultural technologies to the PC server can be implemented, where the PC or Laptop will use the data and the conditional status of the crop as input, process it using Multisim and LabVIEW, providing a stable feedback system for ideal crop nourishing at the least utilization of all required resources.

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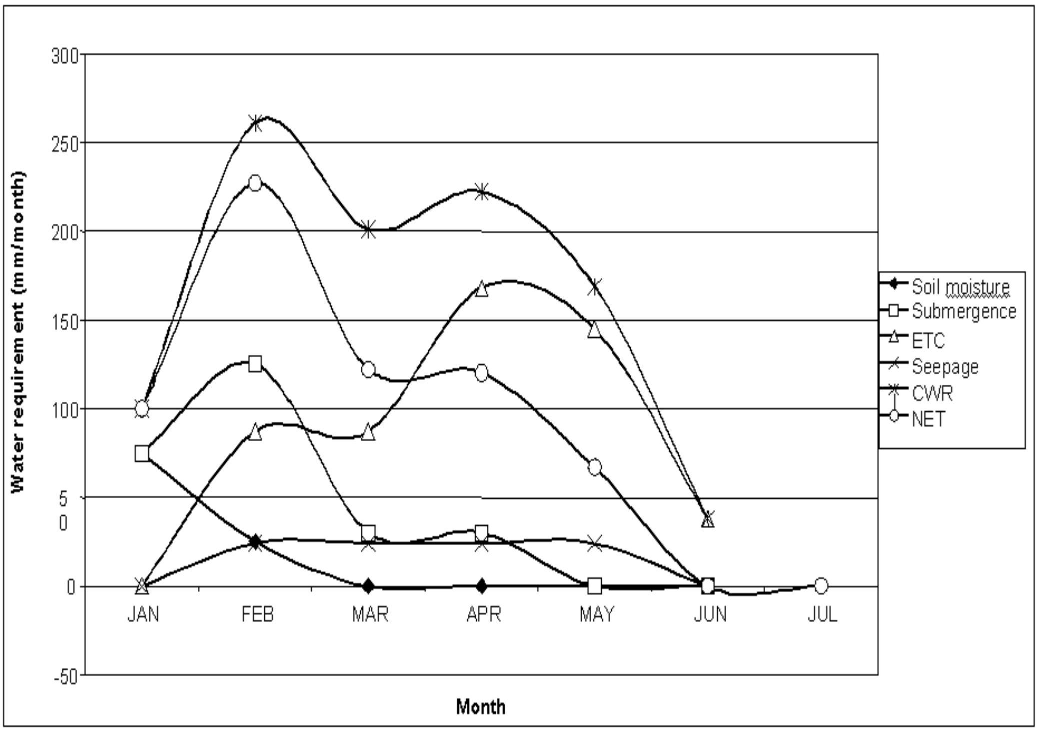


*Note:* Soil moisture = water needs for initial soil saturation; ETC = evapotranspiration; CWR = total crop water requirement; NET = net irrigation requirement.

*Figure 7: Varying water level requirements for Rice crop.*

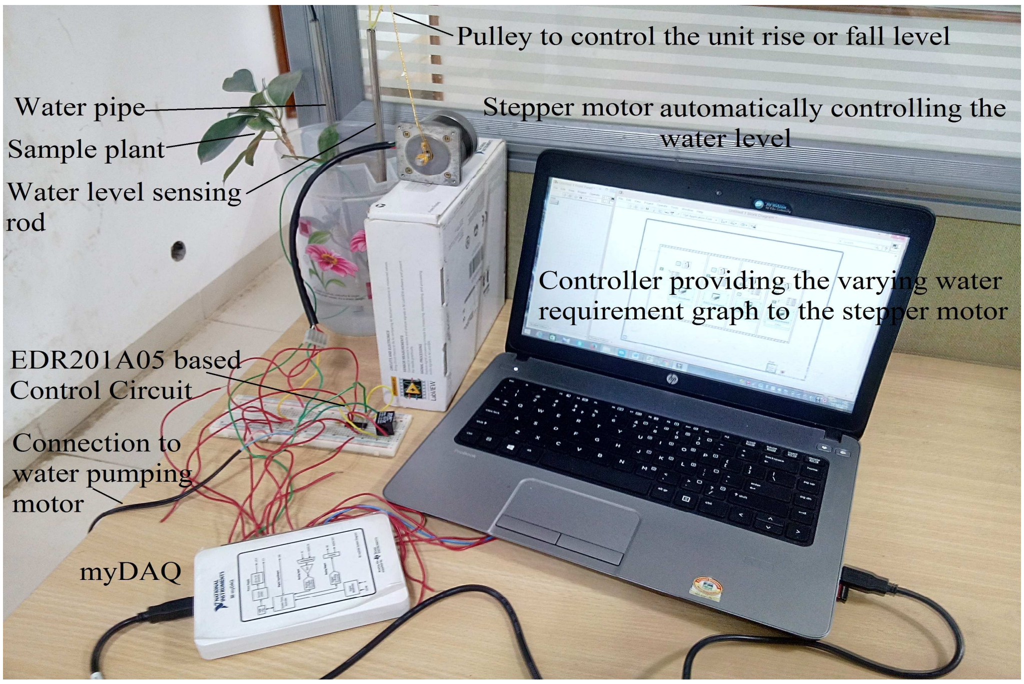


*Figure 8: Experimental setup of the prototype of the system for sample application.*

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