NATIONAL UNIVERSITY OF SCIENCES AND TECHNOLOGY

School of Electrical Engineering and Computer Sciences

DIGITAL LOGIC DESIGN (EE-221)

FINAL PROJECT REPORT

PROJECT TITLE: ***Automatic Irrigation System***

SUBMITTED TO: *Mr. Nasir Mehmood*

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CLASS + SECTION: *BEE-13A*

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Abstract

We have proposed to build an automatic irrigation system as our end semester project. As the world is progressing, humans are moving towards more automated solution to ease their everyday life. Irrigation is very important for our plants and crops. But farmers and gardener having large fields find it tedious to water their crops at uniformly across the area with regular intervals and in adequate amount. Any sort of negligence can directly affect the yield.

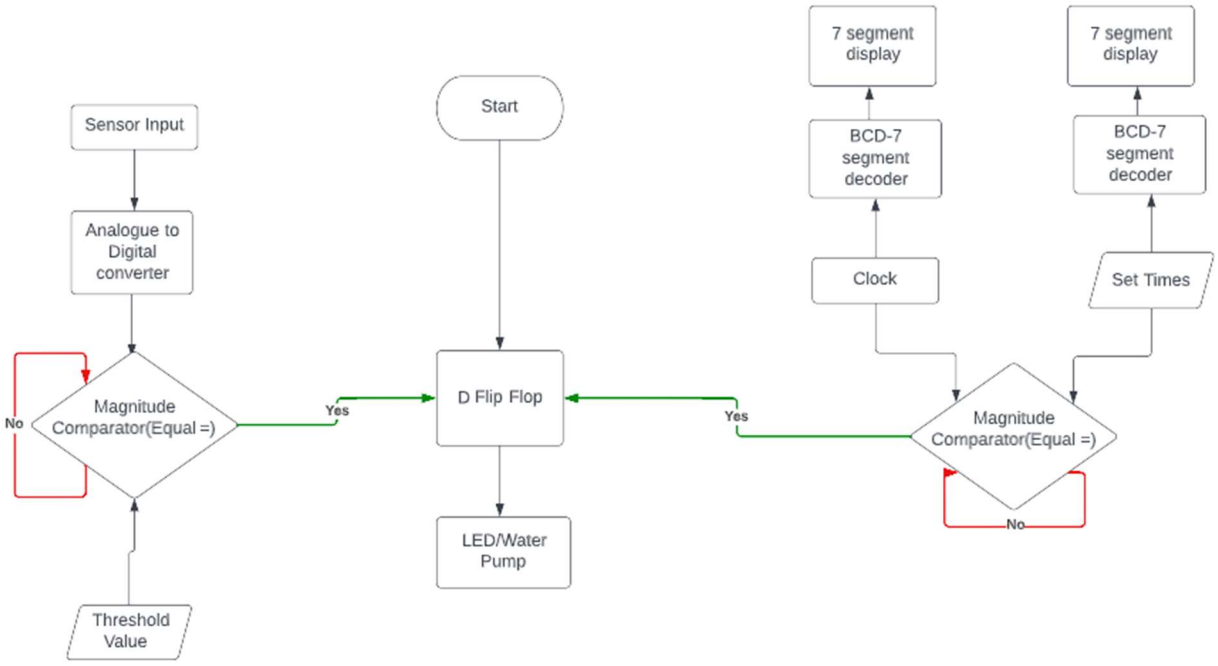
Thus, we have come up with an idea to solve this problem. Automatic Watering systems deliver more controlled watering directly to the roots, reducing water wastage through evaporation or inaccurate watering. Not only does this save water, but it could also save you money on your water bills. So many plants are affected by both under and overwatering, which can potentially kill them or make them more prone to disease. Regular controlled watering produces stronger, happier, and more vibrant plants making your garden look great with less work. Automatic Watering systems allow you to be away from home with the assurance that your garden continues to be watered. No more bothering the neighbors and family or coming back to dead plants.

To achieve this, we will insert a timer connected with the humidity sensor which will collect data at regular intervals. The data is then sent to Analogue to Digital Convertor (ADC) to which is then forwarded to microprocessor. The value will be sent by ADC with the value stored in its memory or the threshold value. If the value is greater than the threshold value, then the signal is sent to Digital to Analogue convertor and then the actuator will turn the sprinkles on. If the value is less than threshold value, then no action will be taken, and the process is repeated.

This solution has a very wide scope as it is the problem of every other person with a fields or garden. Studies show that up to 50% of water usage for landscape irrigation can be saved with Smart Irrigation systems. Moreover, it saves time and increased the product. As a result, Smart systems typically pay for themselves in water savings within short span of time.

Introduction

Our project is automatic irrigation system. In this project the sprinkles will automatically water the plants, only if there is time to water them and there is not much humidity in the soil. This will enable to water the plants on regular intervals and provide water symmetrically. Our project also takes into the account when the weather is already rainy and there is no need ot water the plants. Following block diagram gives us an overview of our project.

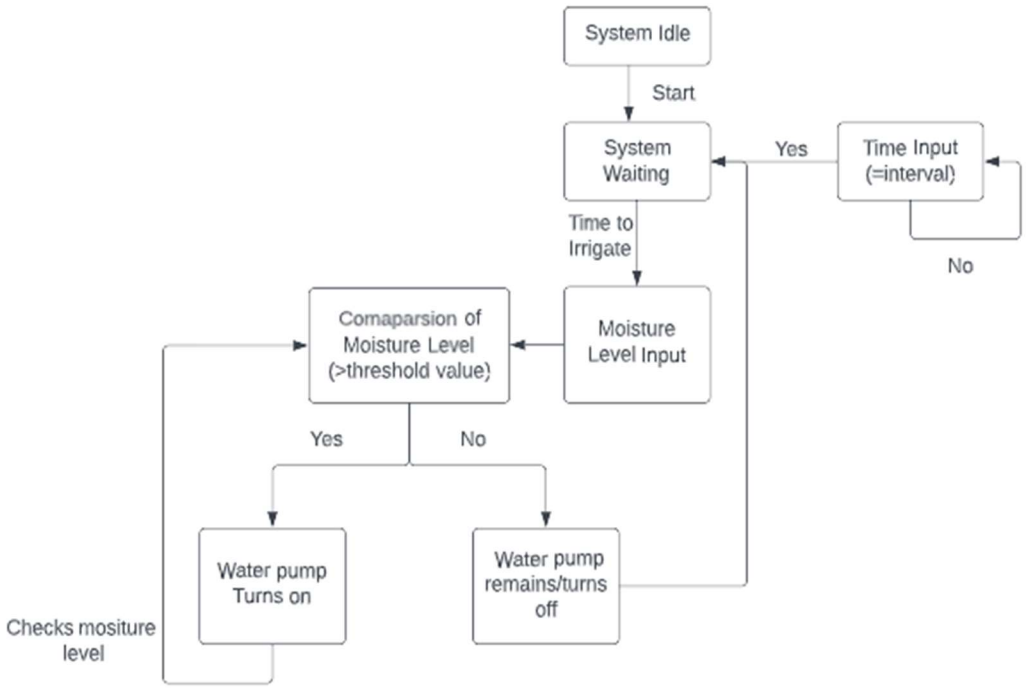


Block Diagram

As we can see that when the system is turned on, the sensor output the value of the moisture to the Analogue to Digital Converter (ADC) which reaches the magnitude comparator to compare the level of moisture to the threshold value. The comparator gives HIGH when the magnitude is less than the threshold value.

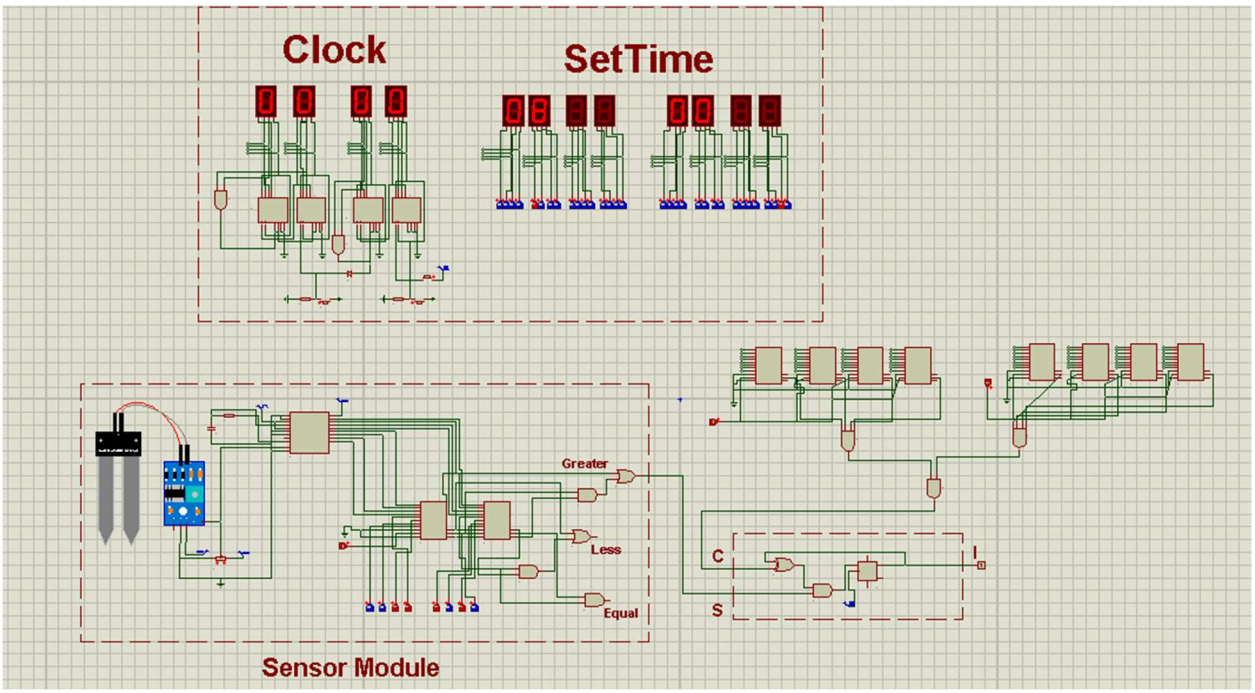
The other is clock module which consist of 24-hr clock and reference times on which we want to water our plants. When the time of clock equal the reference time, magnitude comparator gives HIGH output.

The output from sensor module and clock module is fed into the D Flip Flop which turn the water pump on when it is time to water the plants and moisture is low. The state machine diagram given below further elaborate the working of our system.



State Machine Diagram

The overall structure of our protues simulation is as shown



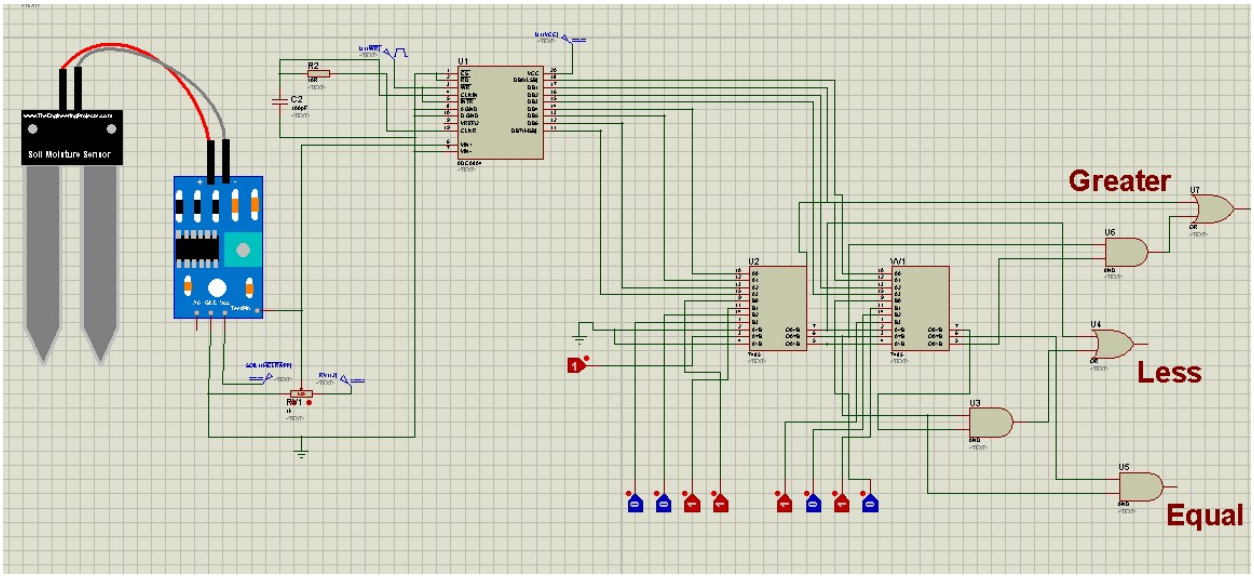
Proteus Simulation

Design Procedure

The design of our system consists of three parts. The clock module, sensor module and LED module. Let us now see the design of each in detail.

Sensor Module:

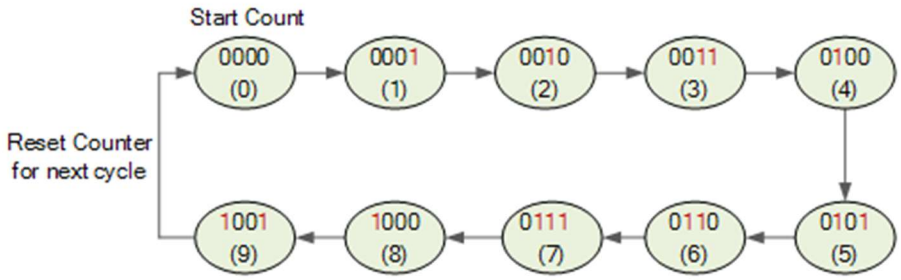
This part includes the soil moisture sensor. The sensor will record the humidity of the soil at regular time intervals. The value that was recorded by the sensor will be analog value. So, we need to convert it to digital value. We use an Analog to digital convertor (adc)(LS0804) for this. The ADC will give us the digital value which will then go to the four-bit magnitude comparator (LS7485). We have used the potentiometer on the resistor as humidity in proteus simulation. The magnitude comparator will tell that the value recorded by the sensor is greater, lesser or equal with the threshold value that is set and stored. If the value recorded by the sensor is greater or equal to threshold value it means that there is already humidity on soil and there is no need to water the plant (which may help to save water and avoid watering plants when it rains). If the value is lesser then it means that humidity is lesser and there is a need to water the plants. The value that will be passed by the comparator in case of less humidity will be 0, which will get ORed and then we have placed an inverter. Following figure show the schematic of the sensor module.



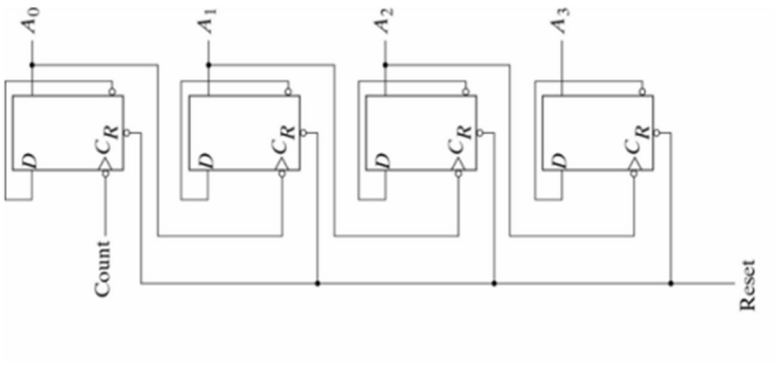
Here it is to be noted that since the value of moisture is in range of 8 bit, we have cascaded two four-bit magnitude comparators to achieve 8-bit comparator.

Clock Module:

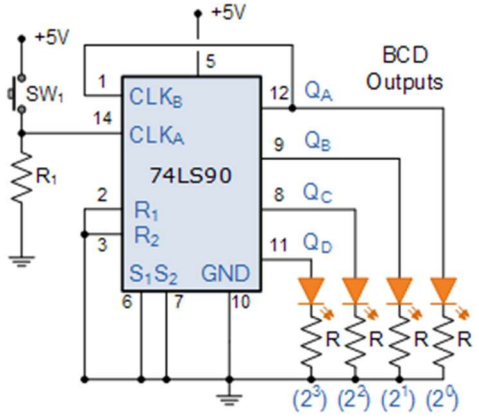
The second half of the circuit contains the sequential part. Here we have made the 24-hour clock which is used to show us the hours and minutes. For every digit of the clock, we have following state diagram



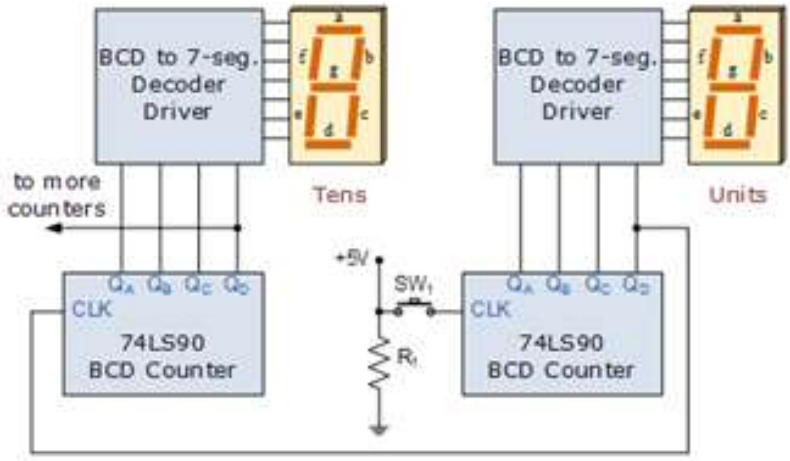
To design such a system, we have made use of ripple counter which uses previous bit as clock trigger to next bit.



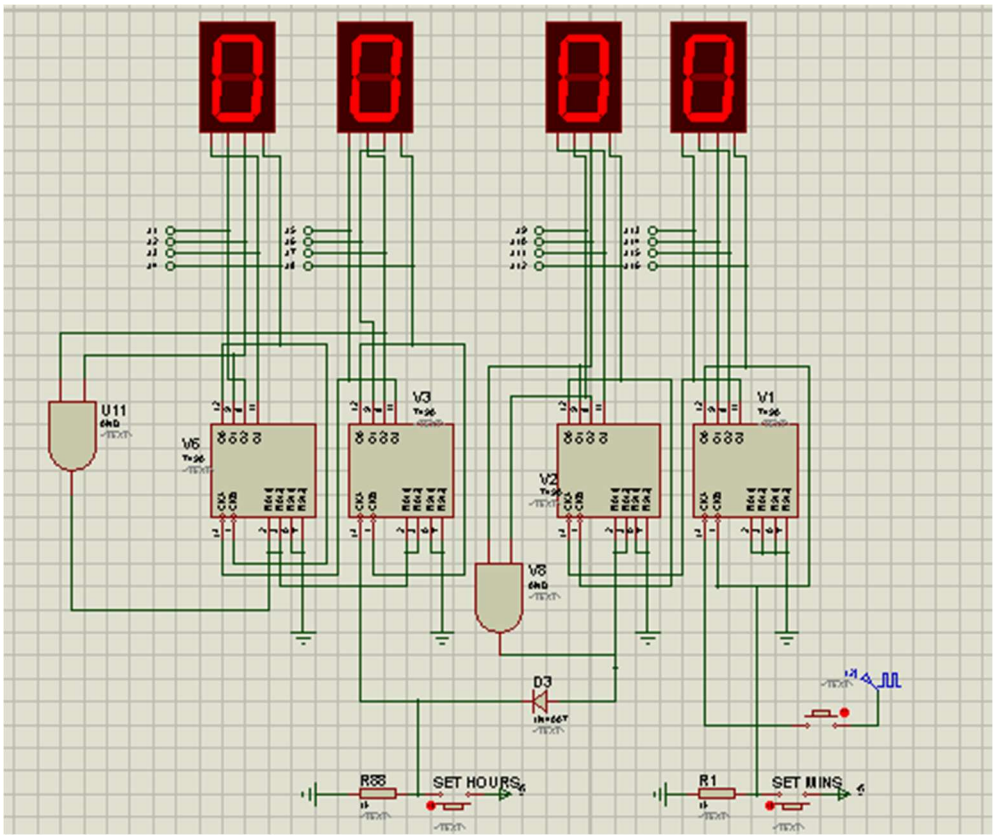
This whole system can be used through decade counter IC (LS7490) as shown



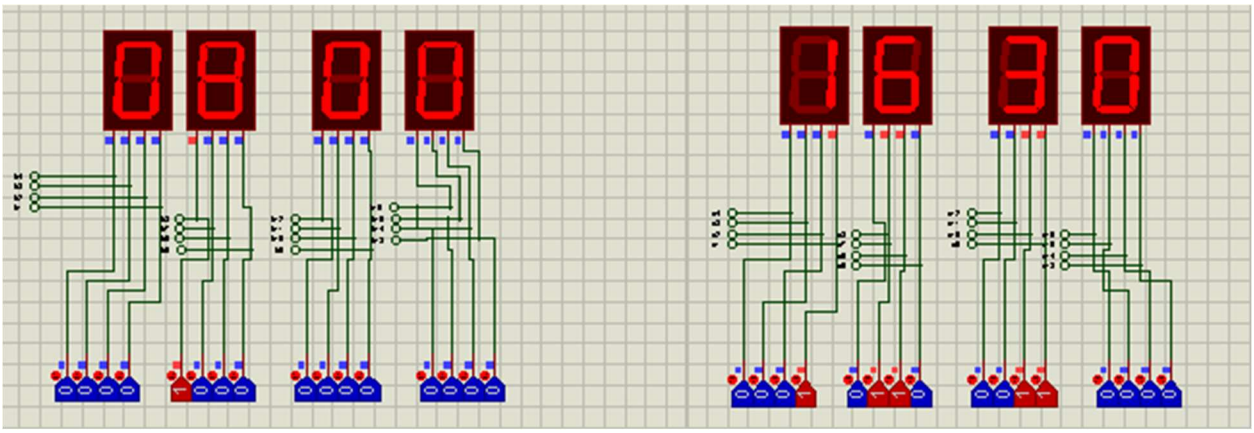
Thus, our final system is as shown below



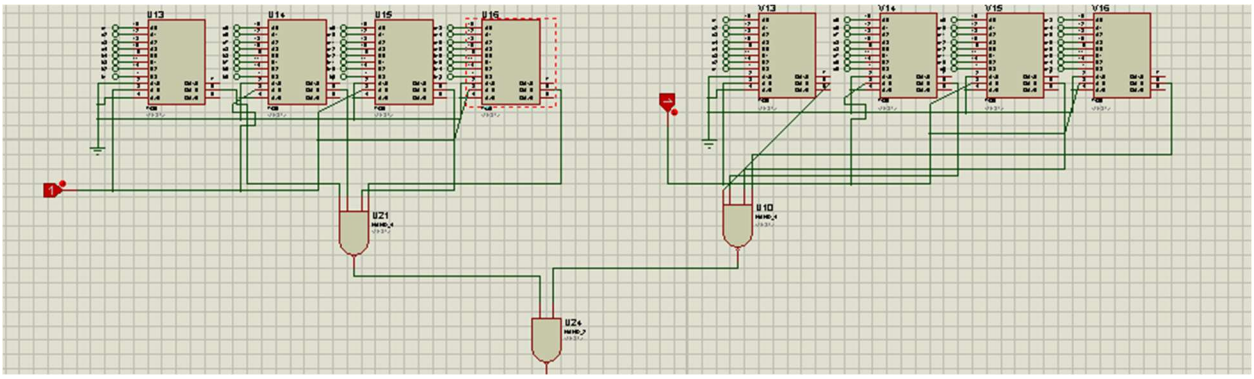
The value displayed by the clock will be in BCD form. We have also made use of buttons through which we can set the clock according to the time we want. There are two separate buttons for hour and minute. This is shown in following schematic.



We also set two reference clocks. These two clocks will tell us the time when to water the plants. We have set two times in proteus simulation that are 8 am and 4 30 pm.

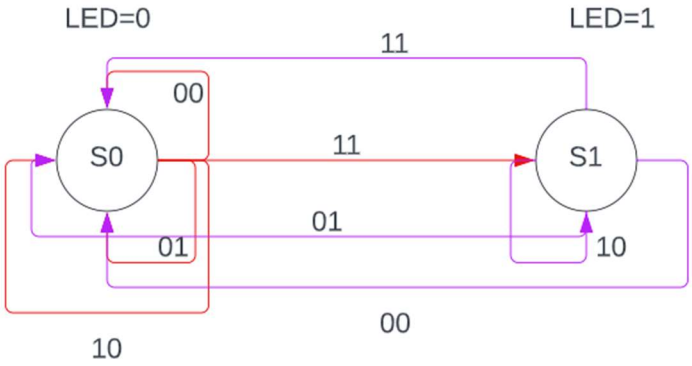


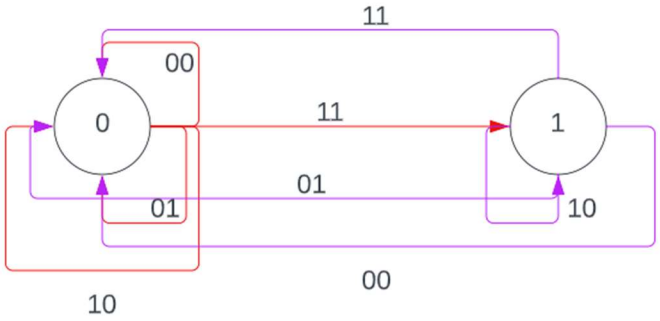
We have then placed four 8-bit magnitude comparators. There are two 8-bit magnitude comparators for two reference clocks. Each BCD value from the reference clocks will get anded with corresponding BCD value of the original clock and then it will get ored. If the time on original clock will match with any of the time on reference clocks, then a signal of 1 will be generated from the or gate as shown in figure below.



LED Module:

To turn the LED on we have made us of D-Flip Flop. We want the LED to turn on when the time is equal to the reference time and the moisture is also low. The LED should remain on until the moisture level reaches the threshold value. Thus, we have following state diagram.





From the above state diagram, we can construct following state table using the excitation table of D-Flip Flop.

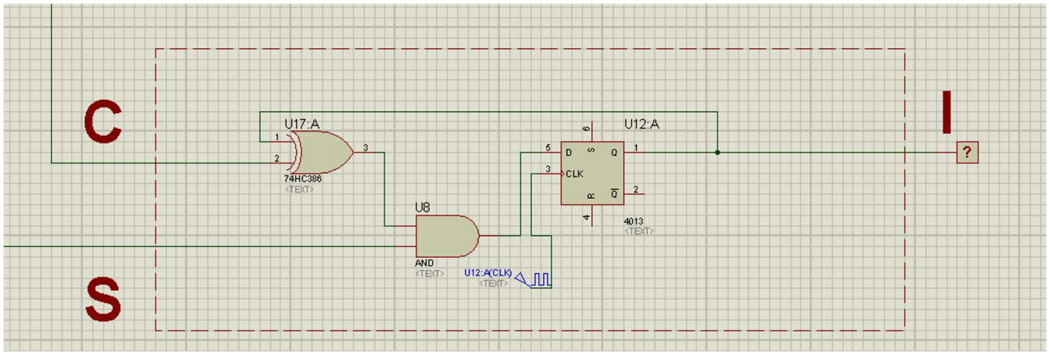
Q	Q_{next}	D
0	0	0
1	0	0
0	1	1
1	1	1

Present State	Input		Next State	D
I(t)	S	C	I(t+1)	
0	0	0	**0**	0
0	0	1	**0**	0
0	1	0	**0**	0
0	1	1	**1**	1
1	0	0	**0**	0
1	0	1	**0**	0
1	1	0	**1**	1
1	1	1	**0**	0

Now we have D function, we can derive the equation for D input as shown below

$$D = I'SC + ISC'$$
$$= S(I'C + IC')$$
$$= S(I \oplus C)$$

From this equation, we can design the LED module as shown



C represents the output of clock module while S represents that of sensor module.

Problems Faced:

Following problems were faced during our project:

- Non-Compatibility of Moisture Sensor which ADC without the use of micro-controller.
- Non-Availability of 8 bit- Analogue to digital converter and 8 bit magnitude comparator.
- Designing the 24-HR clock using decade counter and adding the feature to set the time.

Results achieved:

The final result of our project is that we are able to turn the motor on when it is time to water and the moisture level is below par. We keep the motor on until the level reaches the threshold value. Secondly, we have designed a 24 hr clock which the feature to set the time when the clock is turn on.

Future Recommendations:

- We can further improve our project in future by setting up a record of amount of water used to water plants each day
- Trying to reduce the number of ICs used to make the project smaller in size and reduce the cost in making the project.
- Making it for a much bigger area as our project is just for small scale
- Add feature to turn the pump on when the moisture level drops extremely low even when the time is not yet to water the plants.
- Add a feature to set more than two set times to water the plants using registers so that only system clock is used and it automatically waits for the next set time once the previous set time is reached.