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Water Monitoring System for Hydroponics Agriculture

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Abstract: ***Hydroponics is a concept which is a part of hydro culture and is a method of growing plants in water , without soil using only the mineral nutrient solutions. The nutrients in hydroponics system can be from fish waste, normal nutrients, or duck manure. Hydroponics is a technique in which plant grow without using the soil. This technique take cares that the plant gets all nutrients which are required from the water solution. There are so many types of hydroponics technique. One of the techniques is Water Culture (WC). Water culture is a technique that supplies the nutrient directly to the root of the plant until the plant can be harvested. In this technique, the plant root will be always submerged into the water containing nutrient and oxygen. In this research, the pH level in water solution, water conductivity and the water luminosity which gives bad effect on growing of the plants will be automatically monitor by microcontroller ARM7 and sensors. The proposed system automatically monitors the parameters ph, luminosity and conductivity which are very important for plant growth. Luminosity is the very important factor for the any plant in growth. Requirement of luminosity is vary with plant and the luminosity is vary with environment. So, in proposed system luminosity is monitor and control .***

Keywords: Hydroponics agriculture, pH level, ARM7, Embedded application, monitoring pH, luminosity and water conductivity.

I. INTRODUCTION

Over the past few years, the world's cities are growing very rapidly. So, the farming in an urban area gained a lot of attention. Increasing population compels countries like India to upgrade their agricultural techniques to meet the needs of the people. Soilless agricultural techniques like hydroponics [1] have gained a lot of importance over the years , one of the most popular soilless agricultural technique in which the crops areEspecially, the hydroponics became very important. There are many advantages that hydroponics has over traditional soil-based gardening [2]. Notably, advantages of hydroponics are, it uses less water, less space required, the chance of contamination in this technique is low and it can be done all year round. In addition, by using hydroponics Agriculture, yield is more.

Automation of Hydroponics is a viable concept which can
solve the challenges faced in its implementation [8]. Among all the procedures involved in hydroponics processing, monitoring parameters which is essential for plants growth is very important.

In the proposed system, parameters pH, conductivity, and luminosity are monitor.

II. PROPOSED SYSTEM

The main objective of the hydroponics technique is to supply the ideal nutritional environment for the optimum performance of the plant. In addition, monitor the parameter which affect the plants growth automatically for the better plant performance. These results in reduction of failure of the hydroponics agriculture.

The proposed system for the automatic water monitoring the system for the hydroponics agriculture is as shown in figure.

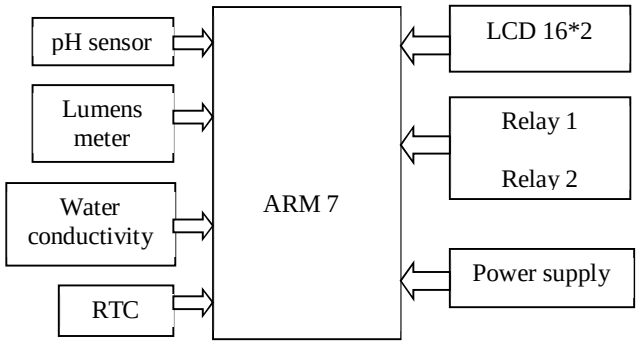


Fig. 1. Diagram of Proposed System

Fig 1 shows the block diagram of the proposed work. By using microcontroller and sensors, monitoring of parameters pH, electrical conductivity (EC), and water luminosity is done. For hydroponics the microcontroller used is advances ARM 7 processor. The microcontroller will continuously monitor the water conditions where the plant is placed. We are monitoring the water PH, Water conductivity and Luminosity to achieve the optimal growth of plants.

In hydroponics the plants need to be kept at a specific Ph value (typically 5 to 5.5). The water that we get in the tap does not have suitable Ph value. The Ph value has to be constantly monitored on daily basis. Also we are monitoring the water conductivity which affects the absorption rate of nutrients by plants. It has to be kept at a given set point.

Giving Light to the plants is another major factor. Each plants Light requirement is different than others. We are measuring the ambient light using our own luminosity meter which will give O/P in Lumens. Also in Hydroponics the plants need to be kept under light for 16 Hours and in the dark for 8 hours to get maximum yield. For this we are using in built RTC of µC through which we will turn ON/OFF the lights every 16 hours or so.

III. SYSTEM METHODOLOGY

A. *Hardware Implementation*

1) *Microcontroller Unit:* The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high-performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The key idea behind Thumb is that of a super-reduced instruction set. Essentially, the ARM7TDMI-S processor has two instruction sets:
   a) The standard 32-bit ARM set.
   b) 16-bit Thumb set.
2) *Lumens Meter:* Photo resistors or Light *Dependent Resistors* (LDR) which change resistance according to light intensity. Normally the resistance of Photo resistor (LDR) decreases with increasing intensity of light falling on it. Photomultiplier tubes containing a photocathode which emits electrons when illuminated, the electrons are then amplified by a chain of dynodes.
3) *Ph Meter:* A pH meter is a scientific instrument that measure the hydrogen-ion activity in water based solutions, indicating its acidity or alkalinity expressed as a pH. The pH meter measures the difference in electrical potential between H pH electrode and a reference electrode, and so the pH meter is sometimes referred to as a "potentiometric pH meter". The difference in electrical potential relates to the acidity or pH of the solution .
4) *Water Conductivity:* Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water [1]. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds
5) *Liquid Crystal Display:* LCD is used in a project to visualize the output of the application. We have used 16x2 LCD which indicates 16 columns and 2 rows. So, we can write 16 characters in each line. So, total 32 characters we can display on 16x2 LCD. LCD can also used in a project to check the output of different modules interfaced with the microcontroller. Thus LCD plays a vital role in a project to see the output and to debug the system module wise in case of system failure in order to rectify the problem.

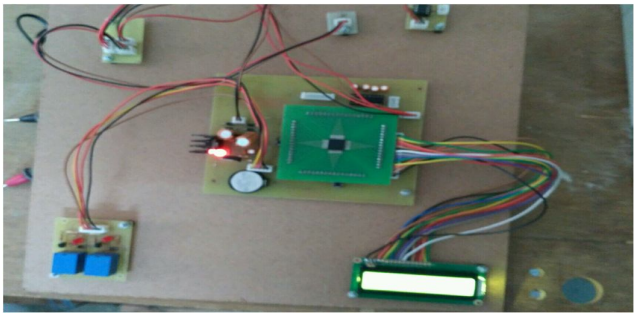


Diagram showing the circuit of the proposed system

B. Software Implementation

1) *KEIL µVISION® IDE :*The µvision ide combines project management, run-time environment, build facilities, source code editing, and program debugging in a single powerful environment. Mvision is easy-to-use and accelerates your embedded software development. Mvision supports multiple screens and allows you to create individual window layouts anywhere on the visual surface. The µVision Debugger provides a single environment in which you may test, verify, and optimize your application code. The debugger includes traditional features like simple and complex breakpoints, watches windows, and execution control and provides full visibility to device peripherals.
2) *Proteus Software:* Proteus Design Suite. The Proteus Design Suite is an Electronic Design Automation (EDA) tool including schematic capture, simulation and PCB Layout modules. It is developed in Yorkshire, England by Labcenter Electronics Ltd with offices in North America and several overseas sales channels.

Steps to use PROTEUS software

Steps :

a) Open Proteus ISIS Schematic Capture.
b) Select the Component Mode from the left Toolbar.
c) Click On P (Pick From Libraries)
d) Add all the required components.
e) Place the components on the workspace.
f) Wire up the circuit.
g) Click on Play Button on the bottom left to start simulation.

IV. PERFORMANCE ANALYSIS

A. Algorithm

1) Start
2) Initialize LCD
3) Display Project Name A
4) Is time=1 sec? Y→ Read RTC → Store and display Date and time on LCD→"B"
5) N→ "B"
6) Is time= 2 seconds? N→"C" Y→
7) Read ADC channel1
8) Store and display PH on LCD
9) Read ADC channel2
10) Store and display Water conductivity on LCD
11) Read ADC channel3
12) Store and display Luminosity on LCD
13) Is luminosity < set point? N -->"C" Y--> Is time =On? N→"C" Y→Turn on Relay 1 Relay 2 & Relay 3 "C"
14) Is current time = set ON time? N→ "D" Y-->Turn ON the Relays-->"A" "D"
15) Is current time = set OFF time? N→ "A" Y→Turn Off relays -->"A"

B. Working Analysis

In this research, I choose cucumber plant for a hydroponics agriculture. Initially, need to saw a seed to germination. Sequence of cucumber seed germination:

1) Kept the seeds in Rockwool. Rockwool is the medium which holds the seeds. That Rockwool is first wet in pH water. For any type of seed pH required is 5.5-6. And the pH of tape water is nearly 6.9-7. So to down the pH used vinegar.

2) Keep this Rockwool in dark place till seed germinate.

3) After 3-4 days seeds get sprouts.
4) After 10 days, monitoring of the plant on daily basis is important.
5) Hydroponic plants required light for 16 hours and complete dark for 8 hours. So, we continuous monitor and control the light.

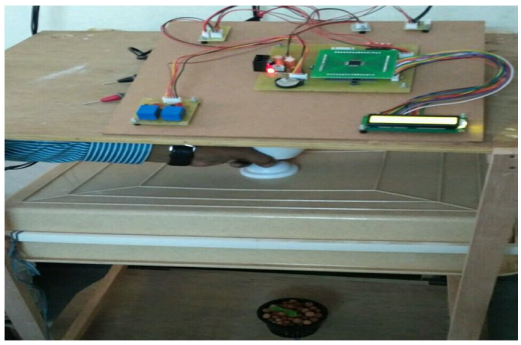
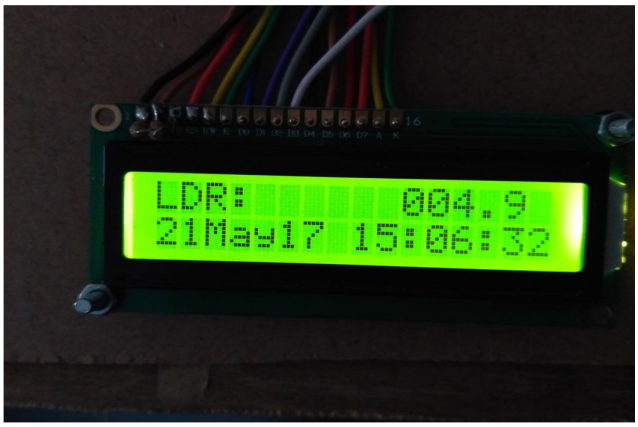


Diagram showing the working analysis of system

V. CONCLUSION

Automation for the hydroponics plant is very important. In the previous researches, only pH is monitored and controlled. But in this research, the parameters conductivity, luminosity and pH is continuous monitor and the light is controlled automatically. Because light is the parameter which changes continuousl. The monitoring of the parameter is done by the sensors and the controlled by the microcontroller ARM 7.

VI. OBSERVATION AND RESULTS



Measuring light continuously and display on LCD. Montoring and controlling of the lumens is done.

After taking care of these parameters, cucumber plant is bloosom.

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