Microcontroller Based automatic AQUAPONICS SYSTEM

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Abstract- *This technical paper begins by introducing the concept of aquaponics, including a brief history of its development and its place within the larger category of soil-less culture and modern agriculture. It discusses the main theoretical concepts of aquaponics, including the nitrogen cycle and the nitrification process, the role of bacteria, and the concept of balancing an aquaponic unit. These project is works on the three groups of living organisms (bacteria, plants and fish) that make up the aquaponic ecosystem.*

The most prevailing issues of the modern world are food and water crises. It is neither possible to consume the pesticide affected food nor grow once own plants, due to scarcity of water and land. Under such conditions, there arises a need for portable agricultural system which uses less water, space and is purely organic. One such solution is a small scale aquaponic system. This system is made by introducing an automation there by there is no need for setting aside extra time for system care. This project has used the data acquired from an existing aquaponic system to design and implement an effective small scale sustainable aquaponic system. This can lead to cost effective, sustainable ways of organic farming independent of the need for comparable land space requirement.

Keywords: Keywords: Aquaponic, embedded, hydroponic, agriculture, microcontroller

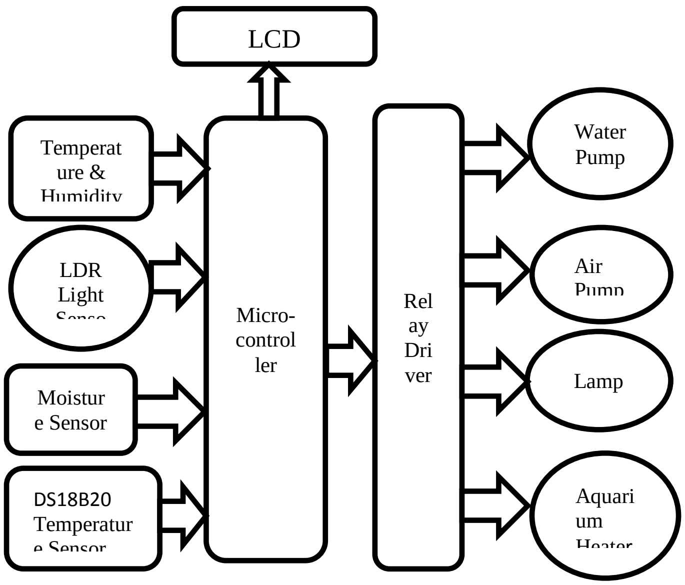
I. INTRODUCTION

The project contains the methodology to build a aquaponic system suitable for different economic strata of the society especially focusing on the urban population where there is evident space and time constraints. This method contributes to one aspect of sustainable household development. In a small scale Aquaponic system, organic vegetables are cultivated in a limited space by recirculating water from a fish tank, rich in nutrients which are essential for the plant growth. Out of all the available water resources on planet Earth, 2.5% is freshwater resource. In this 2.5%, only 0.3% is the readily available freshwater resource accessible to humans. 70% of this limited amount of freshwater available is used for agriculture. Water scarcity already affects almost every continent and more than 40 percent of the people on our planet. By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity and two- thirds of the world's population would be living under water stressed conditions. In 2030, 47% of world population will be living in areas of high water stress. Most population growth will occur in developing countries, mainly in regions that are already experiencing water stress and in areas with limited access to safe drinking water and adequate sanitation facilities. Most of our food requires 100s of liters of water for production and adequate of per crop area for cultivation. The daily drinking water requirement per person is 2-4 liters, but it takes 2000 to 5000 liters of water to produce one person's daily food. In such a situation, a method like aquaponics which is the combination of hydroponics and aquaculture, can contribute effectively to the problem by lowering the amount of water usage for cultivation by 80% and also 75% of the area requirement.

This project is mainly implemented on agriculture and production using natural as well as technical ideas. It is an innovative technique which is brought into play by combination of hydroponics and aquaculture. It can help to reduce oil usage. As the popularity in Aquaponics will increase, the need for chemical nutrients which are derived from oil will decrease, thus reducing oil usage. Aquaponics will reduce fresh drinking water consumption levels by being the most efficient use of water for growing vegetables. It has the most efficient use of nutrients out of all forms of agriculture.

II. SYSTEM MODEL

A. Block Diagram



B. Parts of the System

- Sensors

i. Temperature Sensor
ii. Moisture Sensor
iii. Humidity Sensor
iv. Light Sensor (LDR)

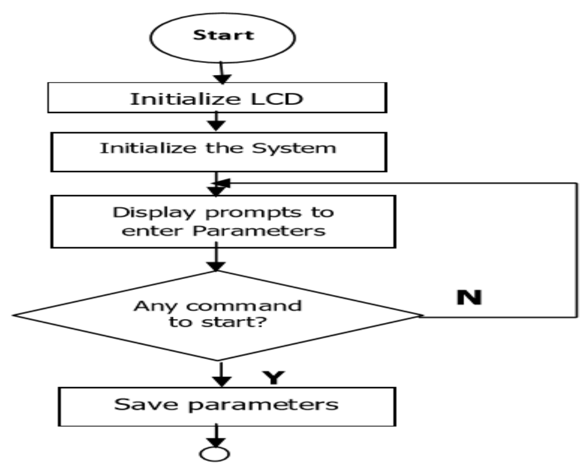
- Liquid crystal Display (LCD)
- Microcontroller ATmega328
- Relays
- DC Motors
- Devices Control

i. Water Pump
ii. Fan
iii. Light
iv. Heater

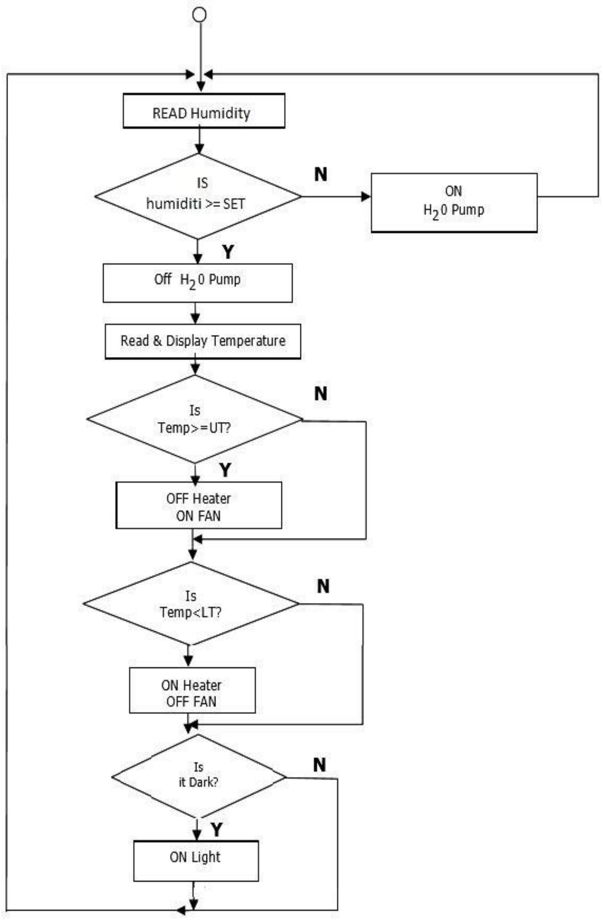
C. Flow of Working

a) Microcontroller ATmega328 is used as it contains inbuilt ADC and this project contains many sensors which need to be given to ADCs.
b) Temperature Sensor gives the indication of the temperature inside the Greenhouse and maintains the required atmospheric condition inside the greenhouse.
c) Moisture sensor full fills the requirement of the water to the plants in the precise manner in order to avoid additional wastage of water.
d) Illumination sensor(LDR) gets activated in order to carry out Photosynthesis Process in the plants.
e) Temperature, Humidity, Moisture is sensed and displayed on LCD and in Graphical form.
f) According to the moisture senses pump to the field will get on/off
g) A relay that drives the pump is switched using switch. This pump will circulate the water between fish tank and field tank.
h) O2 generators will be used for proper health of fishes.

D. Design Implementation Flow Chart



Flow chart 1



Flow chart 2

III.HARDWARE DESCRIPTION

Microcontroller ATmega328

The microcontroller is the heart of the proposed embedded system. The ATmega328 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega328 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

Heater

Fig. 1

It's recommended to fill the aquarium with water that is close to the desired temperature you are trying to achieve. To ensure even and thorough distribution of warmed water and to provide an accurate temperature readings, the heater must be placed in close proximity to a source of water movement. Specifically, it should be placed at the rear of the aquarium, close to a filter or pumps water output. Water must at all times cover the heater at least up to the MIN water level indicated. Always maintain the water level in the aquarium to compensate for water loss due to evaporation.

Moisture Sensor

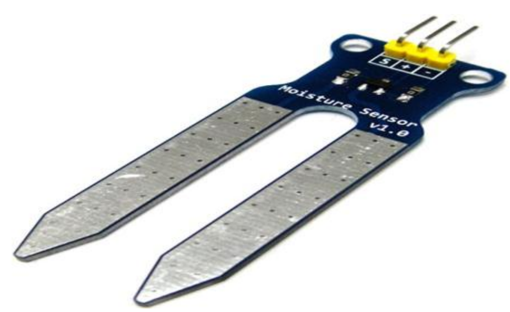


Fig. 2

Most moisture sensors are designed to estimate volumetric water content based on the dielectric constant. The dielectric constant can be thought of as the soil's ability to transmit electricity. The dielectric constant of increases as the water content of the hydrotone increases.. Thus, measurement of the dielectric constant gives a predictable estimation of water content. When the probe is inserted into hydrotone, it generates a small amount of voltage (typically a few hundred milli-volts to a couple of volts). The more water in the soil, the higher the generated voltage.

Water Pump

Fig. 3

A submersible pump (or sub pump, electric submersible pump (ESP)) is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The submersible pumps used in ESP installations are multistage centrifugal pumps operating in a vertical position.

Temperature sensor

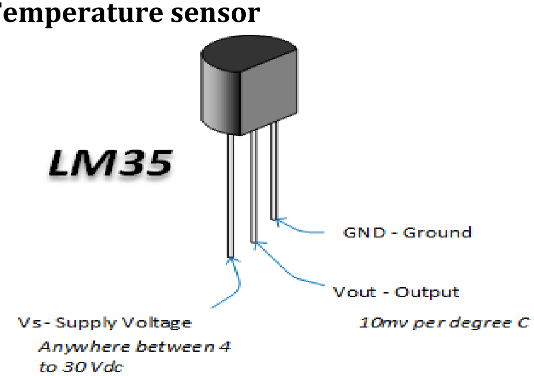


Fig. 4

The LM35 is precision integrated-circuit temperature sensor, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. It can be used with single power supplies, or with plus and minus supplies. +5V supply is provided by using 7805 regulator IC. When IC senses the temperature, it gives linear voltage as +10.0mV/°C at the Vout pin of IC. This Vout pin is connected to the +V(IN) of A/D Converter.

LCD (Liquid Crystal Display)

Fig. 5

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferre over seven segments and other multi segment LEDs.

IV. Tests and Results

Circuit	**Output (dc-voltage)**	**Display**
Temperature sensor (35) • Ice (0° c) • Boil water (100° c)	0 v 1 v	Tested ok
Water sensor • Sense water • Sense no water	0 v 3.8 v	Tested ok
Lighting sensor • Dark environment • Bright environment	0 v 2v- 4v	Tested ok
Push button • Closed circuit (PUSH) • Open circuit	0v 5v	Reliable

(normal)		
Microcontroller output • Data logic 1 • Data logic 0	 4.7v 0v	Tested ok

V. ADVANTAGES

i. Sustainable and intensive food production system.

ii. Two agricultural products (fish and vegetables) are produced from one nitrogen source.

iii. Extremely water efficient.

iv. Does not require soil.

v. Does not use fertilizer and chemical pesticides.

vi. Higher yields and qualitative production.

vii. Higher level of Biosecurity and lower risk from outer contaminants..

viii. Can be used on non-arable land such as deserts, degraded soil or salty sandy islands.

VI. CONCLUSION

Aquaponic system is certainly the best solution for growing organic vegetables at homes in crowded cities as the space and water requirement for this system is less. It is an eco-friendly technology which can be improvised and made energy efficient at an individual's convenience and pattern of usage. The recirculation of water makes the water requirement for cultivation less and water compensations weekly have to be made for evaporation losses only.

VII. REFERENCE

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