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AQUAPONICS BASED FARMING SYSTEM

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Abstract:-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 thereby there is no need for setting aside extra time for systemcare. 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: **GSM, Automation, Photosynthesis, Pisciculture.**

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.

II. SYSTEM MODEL

A. Block Diagram & Explanation

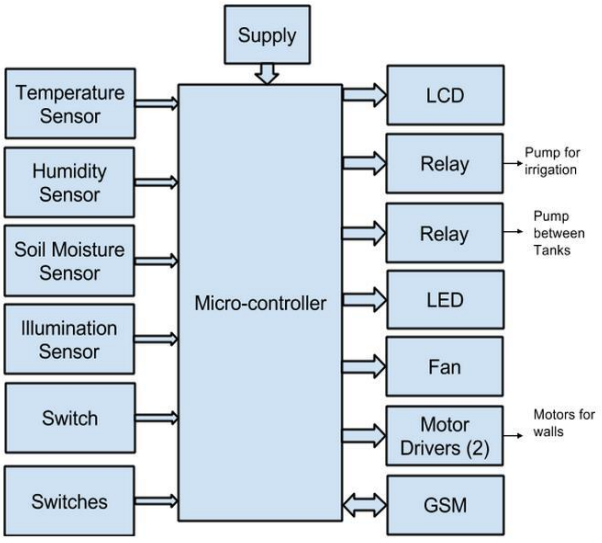

Fig 1.Block Diagram of the System

B. Parts of the System

- Sensors
  - i. Temperature Sensor
  - ii. Humidity Sensor
  - iii. Light Sensor (LDR)
  - iv. Soil Moisture Sensor
- Global System for Mobile Communication (GSM)
- Liquid crystal Display (LCD)
- Graphical Analysis
- Analog to Digital Converter
- Microcontroller AVR (AT89S52)
- Liquid Crystal Display
- Relays
- DC Motors
- Devices Control
  - i. Water Pump
  - ii. Motors (Roof controlling)
  - iii. Fan(Stimulated for Cooling)
  - iv. Pump (Water to and fro)

C. Flow of Working

i. Microcontroller AVR is used as it contains inbuilt ADC and this project contains many sensors which need to be given to ADCs.

ii. Temperature Sensor gives the indication of the temperature inside the Greenhouse and maintains the required atmospheric condition inside the greenhouse.

iii. Soil Moisture sensor fulfills the requirement of the water to the plants in the precise manner in order to avoid additional wastage of water.

iv. Illumination sensor(LDR) gets activated in order to carry out Photosynthesis Process in the plants.

v. Temperature, Humidity, Soil Moisture is sensed and displayed on LCD and in Graphical form.

vi. Whenever the farmer wants to know the weather condition he will message the GSM a predefined word and the system will revert temp and humidity values.

vii. According to the soil moisture senses pump to the field will get on/off

viii. During the day time sensed by illumination sensor led will turn off and at the night time leds will be on and will turn ON the motors of the Roof Top and Sidewall in order to pass the Oxygen.

ix. Similarly if the temperature goes above threshold the fan will get on and below it fan will be off.

x. A relay that drives the pump is switched using switch. This pump will circulate the water between fish tank and field tank.

xi. O2 generators will be used for proper health of fishes.

III. HARDWARE DESCRIPTION

i. Microcontroller (ATs8952)

The microcontroller is the heart of the proposed embedded system.

Fig 2. Atmega16 Microcontroller

The ATmega16 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 ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

ii. Day Light Sensor

L14G2 is an NPN phototransistor. It acts as a photo detector in the sense that it can convert the incident light into electric response. They are commonly used as sensors usually paired with a light source like LED.

Fig 3. L14G2

These are the bipolar transistors having a transparent case. This transparent case exposes the base collector region of transistor to external light. When light incidents on this junction, electrons are generated by the photons. These electrons are injected in the base of phototransistor. The current gain of the transistor amplifies the resulting photocurrent at the base collector junction. Thus a phototransistor conducts in the presence of light and remains in off mode in absence of light. The maximum dark current is 100nA; while in light its current is 500µA.

iii. LED (Light Emitting Diode)

LEDs offer benefits such as small size, long lamp life, low heat output, energy savings and durability. They also allow extraordinary design flexibility in color changing, dimming and distribution by combining these small units into desired shapes, colors, sizes and lumen packages. LEDs are solid state semiconductor devices.

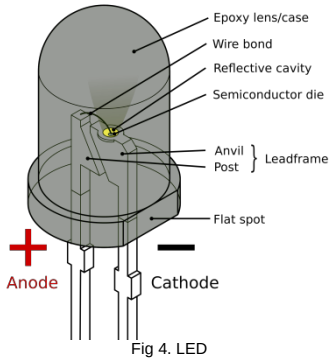

Fig 4. LED

iv. Motor Driver

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC, Dual H-bridge Motor Driver integrated circuit (IC).

Fig 5. L293D Motor Driver

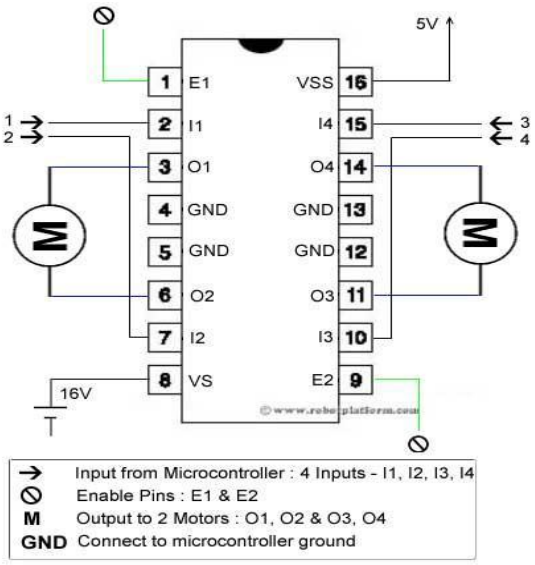

Fig 6. Pin Configuration of Motor Driver - L293D IC.

LOGIC TABLE 1.

Pin 1	Pin 2	Pin 7	Function
High	High	Low	Turn Anti-clockwise (Reverse)
High	Low	High	Turn clockwise (Forward)
High	High	High	Stop
High	Low	Low	Stop
Low	X	X	Stop

High ~+5V, Low ~0V, X=Either high or low (don't care)

v. DC Motor

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is

then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

Fig 7. DC Motor

vi.Switches

A switch is a component which controls the openness or closeness of an electric circuit. They allow control over current flow in a circuit (without having to actually get in there and manually cut or splice the wires). Switches are critical components in any circuit which requires user interaction or control a switch can only exist in one of two states: open or closed. In the off state, a switch looks like an open gap in the circuit. This, in effect, looks like an open circuit, preventing current from flowing. In the on state, a switch acts just like a piece of perfectly-conducting wire.

Fig 8.Switches

vii. Relay

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier.

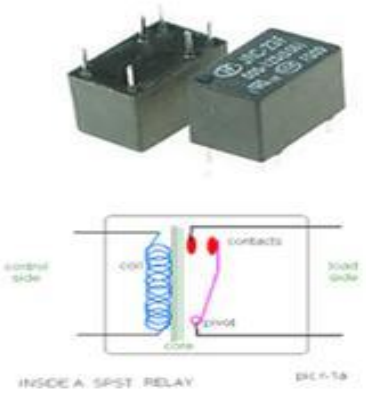

Fig 9.Relay

viii. Moisture Sensor

Most soil moisture sensors are designed to estimate soil volumetric water content based on the dielectric constant (soil bulk permittivity) of the soil. The dielectric constant can be thought of as the soil's ability to transmit electricity. The dielectric constant of soil increases as the water content of the soil increases.. Thus, measurement of the dielectric constant gives a predictable estimation of water content. When the probe is inserted into soil, 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.

Fig 10.Soil Moisture Sensor

ix. Pump

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.

Fig 11.Pump

x. Temperature sensor

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..

Fig 12.Temperature sensor

xi. LCD (Liquid Crystal Display)

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 preferred over seven segments and other multi segment LEDs.

Fig 13.LCD

xii. GSM

GSM stands for Global System for Mobile Communications. It is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones.A GSM Modem is a device that modulates and demodulates the GSM signals and in this particular case 2G signals.

Fig 14. GSM MODEM

Fig 15. Hardware Description

a. SIM (Subscriber Identity Module) Card Slot

While inserting in and removing out SIM card from SIM card slot, User needs to take precaution that power supply should be OFF so that after making Power supply ON it will be easy to reinitialize with SIM for this module.

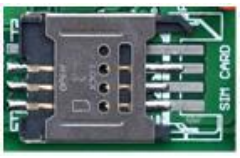

Fig 16.SIM Module

b. RXD, TXD and GND pins

These pins are used to connect devices which needs to be connected to GSM module through USART (Universal Synchronous Asynchronous Receiver and Transmitter) communication. Devices may be like Desktop or Laptop Computer System, Microcontrollers, etc. RXD (Receive Data) should be connected to TXD (Transmit Data) of other device and viceversa, whereas GND (Ground) should be connected to other device's GND pin to make ground common for both systems.

Fig 17.RXD, TXD, GND pin

IV. SOFTWARE DESCRIPTION

i. Diptrace for PCB Layout
ii. winavr for microcontroller programming in Embedded C

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.
ix. Creates little waste.

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.

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