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DESIGN OF CUSTOMIZED COMPACT HYDROPONICS FOR FODDER SYSTEM

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ABSTRACT

Hydroponics is a modern farming technique proposed as an alternative to traditional farming. Hydroponics agriculture is a soilless cultivation method where the plant is grown with the help of nutrients and water alone and hence it provides a solution to the growing scarcity of agricultural land. In this work, a hydroponics farming setup is designed and developed specifically for the cultivation of green fodder required for livestock rearing. Commercially available hydroponic based fodder cultivation setups use a timer-based water spraying system for maintaining the moisture required for the growth of the plants and it does not account for external environmental conditions. In the proposed setup the changes in the weather and environmental conditions would be considered and accordingly the moisture retention required for the fodder cultivation will be maintained. A custom mobile application is also developed specifically for the proposed setup which helps in continuous monitoring of the system. Thus the proposed hydroponic setup requires minimal manual labour except for sowing and harvesting and it helps in ensuring proper moisture content based on the environmental conditions and hence efficient plant growth also through continuous monitoring and supply of nutrients based on the crops growth.

KEYWORDS: Precise positioning, tracking, automatic execution, events triggering, location data, commercial applications, recreational applications.

1. INTRODUCTION

Hydroponics is a modern farming technique proposed as an alternative to traditional farming. Hydroponics agriculture is a soil less cultivation method where the plant is grown with the help of nutrients and water alone and hence it provides a solution to the growing scarcity of agricultural land. In this work a hydroponics farming setup is designed and developed specifically for the cultivation of green fodder required for livestock rearing. Commercially available hydroponic based fodder cultivation setups use a timer-based water spraying system for maintaining the moisture required for the growth of the plants and it does not account for external environmental conditions. In the proposed setup the changes in the weather and environmental conditions would be considered and accordingly the moisture retention required for the fodder cultivation would be maintained.The developed setup also has an inbuilt Internet of things (IoT) feature that provides the capability to monitor the system remotely through a mobile application. A custom mobile application is also developed specifically for the proposed setup which helps in continuous monitoring of the system. Thus the proposed hydroponic setup requires minimal manual labour except for sowing and harvesting and it helps in ensuring proper moisture content based on the environmental conditions and hence efficient plant growth also through continuous monitoring and supply of nutrients based on the crop's growth.

2. WORKING

The proposed system aims to develop an advanced hydroponic fodder system using a PIC microcontroller to optimize the growth of nutritious animal feed. The system incorporates sensor-based monitoring and control mechanisms to ensure water efficiency, nutrient balance, and environmental conditions for efficient feed production. A user interface will be integrated to display real-time data and enable manual adjustments. This project aligns with the goal of sustainable agriculture by producing high-quality animal feed using minimal resources. The demand for sustainable and efficient agricultural practices has led to the development of innovative technologies, such as hydroponic systems, to cultivate nutrient-rich fodder.

This abstract presents an automated hydroponic fodder system that utilizes a PIC microcontroller to regulate and optimize the growth of fodder for livestock. Hydroponic fodder cultivation involves growing nutritious grains without soil, using a controlled environment that promotes rapid germination and growth. The proposed system employs a PIC microcontroller to monitor and adjust key parameters critical for fodder growth, including temperature, humidity, light intensity, and nutrient solution distribution. Sensors are integrated to collect real-time data, ensuring precise control over the growing conditions.

PIC 16F877A is a low power, Hydroponics Nutrition Plants Systems and prototype This hydroponics system plant is placed in a special chamber or vessel and the nutrients are sent directly to the hydroponic roots at any given time. Controller will control the flow of water on. The program module has been embedded in controller is used in real-time to set Alarms on nutrient pumps. When the alarm is on Enabled, Relay will be activated and the nutrient pump will drain the Nutrition solution on the hydroponics plant. When the alarm is deactivated, the relay will be extinguished and the nutrient pump will stop supplying.When power is switched ON the microcontroller based battery bank protection message is displayed on the LCD along with a short beep from Piezo Buzzer (PZ). Simultaneously the Real Time is read from RTC IC DS1307 and is displayed in LCD. When the room temperature rises above 45°C the microcontroller gives continuous alarm and also output will be cut off. The hydroponic fodder system utilizes the benefits of hydroponics to cultivate animal feed in a controlled environment. Integration with a PIC microcontroller enhances automation and precision.

3. MATERIALS AND METHODOLOGY

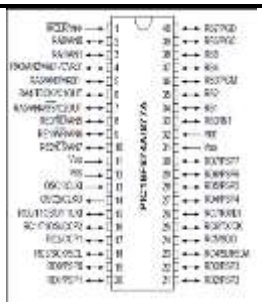
Identify specific requirements including crop type, space limitations, and available resources. Study various hydroponic techniques suitable for compact spaces and fodder production. Choose the most appropriate hydroponic system based on analysis and requirements. Select components such as containers, irrigation systems, lighting, and nutrient solutions compatible with the chosen system. Develop a detailed layout plan considering spatial constraints and accessibility. Design an efficient irrigation system tailored to crop needs and chosen hydroponic technique. Calculate lighting requirements and position LED grow lights strategically for even coverage. Develop a strategy to maintain optimal temperature and humidity levels using ventilation and automation. Create a nutrient solution recipe and establish dosing and monitoring protocols. Conduct tests, monitor growth, and make adjustments to optimize system performance continuously.

PIC 16F877A

The PIC 16F877A has 14KB of flash memory for program storage and 368 bytes of RAM for data storage. It has a built-in 10-bit Analog-to Digital Converter (ADC) that allows it to read analog signals and convert them to digital data. It also has various communication interfaces, such as USART, SPI, and I2C, which make it suitable for communication with other devices. The microcontroller having 35 input/output (I/O) pins, which can be configured as digital inputs or outputs, or as analog inputs. It also has timers, which can be used for various timing functions, such as measuring time intervals, s, automotive systems, home automation, robotics, and more. Its popularity is due in part to the fact that it is easy to program and has a large user base, which makes it easy to find resources and support. PIC 16F877A has low power consumption, which makes it suitable for battery-powered applications. It also features a wide operating voltage range and can operate in harsh environments due to its high temperature range.

PIC 16F877A

PIC MICROCONTROLLER PIN CONFIGURATION



PIN CONFIGURATION

16*2 LCD

The LCD module typically has a built-in controller that can be interfaced with a microcontroller or other device to display text and simple graphics. The controller communicates with the microcontroller using a parallel or serial interface, which allows the microcontroller to send data and commands to the LCD module is 16x2 LCD modules that have 16 pins, with 8 pins used for data and 3 pins used for control signals.

16*2 LCD

The data pins are used to send the character data to be displayed, while the control signals are used to send commands to the LCD module, such as clear screen, move cursor, and set display mode. The module also has a backlight, which can be controlled using additional pins. 22 The backlight is typically powered by a separate power supply, and can be turned on or off using a control signal. To use a 16x2 LCD module, it has to be connected to a microcontroller or other device using the appropriate interface. The 16*2 LCD display can also include various features such as backlighting, contrast adjustment, and programmable characters, which can enhance its functionality and usability.

SPEED SENSOR

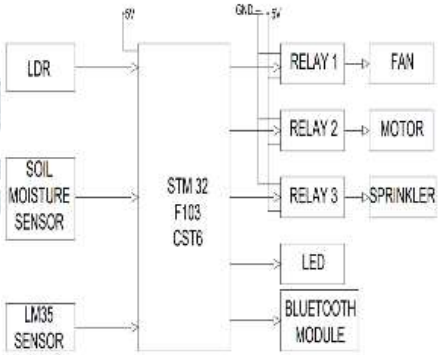
A speed sensor is a type of position sensor which is used to measure rotational speed. They are present in various types of commercial and motorsport vehicles. Like many devices, a speed sensor is an integral part of onboard system This sensor is used to measure the speed of motors. It uses an encoder disk with holes (here: 20), which pass through a light barrier. This disk is normally fixed to the shaft of the motor. The light barrier can count the holes of the encoder disk so that the rotations can be counted.

SPEED SENSOR

WORKING PRINCIPLE OF THE BUZZER

The working principle of a buzzer depends on the theory that, once the voltage is given across a piezoelectric material, then a pressure difference is produced. A piezo type includes piezo crystals among two conductors. Once a potential disparity is given across these crystals, then they thrust one conductor & drag the additional conductor through their internal property. The magnetic type is more fixed as compared to the type because they work through a magnetic field. Magnetic buzzers utilize an electric charge instead of depending on piezo materials to generate a magnetic field, after that it permits another element of the buzzer to vibrate & generate sound. The applications of magnetic buzzers are similar to the piezo type in household devices, alarms such as watches, clocks & keyboards**.**

BLOCK DIAGRAM



BLOCK DIAGRAM

In the proposed system three sensors are connected. Bluetooth is connected in the mobile application to give the instruction. The proposed work uses one is temperature sensor and another's are humidity sensor and IR sensor .All the values are monitor in the mobile application app by the help of Bluetooth module.

LDR

LDR (Light Dependent Resistor) as the name states is a special type of resistor that works on the photoconductivity principle means that resistance changes according to the intensity of light. Its resistance decreases with an increase in the intensity of light. It is often used as a light sensor, light meter, Automatic street

light, and in areas where need to have light sensitivity. It is also called a Light Sensor.LDR are usually available in 5mm, 8mm, 12mm, and 25mm dimensions.LDR .

LDR

BLUETOOTH MODULE

The Bluetooth module HC-05 which is a master/slave module. The data collected by the moisture sensor is transferred to the android application in the smart phone via Bluetooth technology using this module. It works on serial communication. This technology achieves its goal by embedding tiny, inexpensive, short-range transceivers into the electronic devices that are available today. Each device has a unique 48-bit address from the IEEE 802 standard.

Bluetooth

The maximum range is 10 meters but can be extended to 100 meters by increasing the power. Bluetooth Module 16 3.6.1 Specification of the Bluetooth module Bluetooth version: 2.0

THREE CHANNEL RELAY MODUL

The 3 Channel Relay Module is a convenient board which can be used to control high voltage, high current load such as motor, solenoid valves, lamps and AC load. It is designed to interface with microcontroller such as Arduino, PIC and etc. The relays terminal (COM, NO and NC) is being brought out with screw terminal. The four-channel relay module contains four 5V relays and the associated switching and isolating components, which makes interfacing with a microcontroller or sensor easy with minimum components and connections. The contacts on each relay are specified for 250VAC and 30VDC and 10A in each case, as marked on the body of the relays. Three-channel relay module contain four 5V relays and the associated switching and isolating components, which makes interfacing with a microcontroller .

The terminals are screw type, which makes connections to mains wiring easy and changeable. The contacts on each relay are specified for 250VAC and 30VDC and 10A in each case, as marked on the body of the relays. The switching transistors act as a buffer between the relay coils that require high currents, and the inputs which don't draw much current. The indicator LEDs glow when the coil of the respective relay is energized, indicating that the relay is active. The input jumper contains the main VCC, GND, and input pins for easy connection using female jumper wires

Three Channel Relay Module

POWER SUPPLY

Power supply is a reference to a source of electrical power shown. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a Power Supply Unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. Power supplies for electronic devices can be broadly divided into linear and switching power supplies. The linear supply is a relatively 24 simple design that becomes increasingly bulky and heavy for high current devices; voltage regulation in a linear supply can result in low efficiency. A switched-mode supply of the same rating as a linear supply will be smaller, is usually more efficient, but will be more complex. It will supply a voltage up to 12V for the Arduino board.

Power supply

PUSH BUTTON

A push-button or simply button is a simple switch mechanism to be control some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate to the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches, although many un-biased buttons (due to their physical nature) still require to a spring to return to their un-pushed state.

push-button

The "push-button" has been utilized in calculators, push-button telephones, kitchen appliances, and various other mechanical and electronic devices, home and commercial. In industrial and commercial applications, push buttons can be connected together by a mechanical linkage so that the act of pushing one button causes the other button to be released. In this way, a stop button can "force" a start button to be released. This method of linkage is used in simple manual operations in which the machine or process has no electrical circuits for control.

TEMPERATURE AND HUMIDITY SENSOR

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record monitor or signal temperature changes. There are many different types of temperature sensors. Here you can get a variety of Temperature & Humidity sensor which includes Digital Microcomputer Thermostat Switch. Humidity Controller Module high-temperature resistance Probe. Moisture Sensor and many more modules.

Temperature sensor

There Temperature Sensor applications in many industries including medical motorsport. HVAC, agriculture, industrial. aerospace and automotive. In may applications where main taming a specific temperature is vital there the temperature sensor is used, for example, if products must be kept at a certain temperature or for patient monitoring. the responsiveness and accuracy of the temperature sensor are critical.

INFRARED (IR) SENSOR

An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment. Infrared radiation was accidentally discovered by an astronomer named William Herchel in 1800. While measuring the temperature of each colour of light (separated by a prism), he noticed that the temperature just beyond the red light was highest. IR is invisible to the human eye, as its wavelength is longer than that of visible light (though it is still on the same electromagnetic spectrum). Anything that emits heat gives off infrared radiation. There are different types of infrared transmitters depending on their wavelengths, output power and response time. An IR sensor consists of an IR LED and an IR Photodiode, together they are called as Photo Coupler or OptoCoupler.

Infrared (IR) sensor

SPRINKLER IRRIGATION SYSTEM

Sprinkler irrigation is a modern type of irrigation system in which perpendicular pipes having rotating nozzles are attached to horizontal pipes. It irrigates the crops by sprinkling water on them in the same way as rain do. Sprinkler irrigation system allows application of water under high pressure with the help of a pump. It releases water similar to rainfall through a small diameter nozzle placed in the pipes. Water is distributed through a system of pipes, sprayed into air and irrigates in most of the soil type due to wide range of discharge capacity. Tubings-main/submains and laterals,Couplers,Sprinker head ,Other accessories such as valves, bends, plugs and risers.

Sprinkler

STM32 MICROCONTROLLERS

The STM32 is a family of microcontroller ICs based on various 32-bit RISC ARM Cortex-M cores. STMicroelectronics licenses the ARM Processor IP from ARM Holdings. The ARM core designs have numerous configurable options, and ST chooses the individual configuration to use for each design. ST attaches its own peripherals to the core before converting the design into a silicon die. The following tables summarize the STM32 microcontroller families.STM32 microcontrollers are a family of 32-bit ARM Cortex M based microcontrollers developed by STMicroelectronics. These microcontrollers are characterized by their high-performance computing capabilities and low power consumption. They are designed to meet the growing demands of embedded systems, providing a reliable and efficient solution for a wide range of applications. The basic working principle of STM32 microcontrollers involves the execution of instructions stored in their flash memory. These instructions are fetched and decoded by the microcontroller, and the corresponding operations are performed. This allows the microcontroller to control various peripherals and interact with the external world.

STM32

5. CONCLUSION

In conclusion, the implementation of a hydroponic fooder system offers numerous advantages in terms of sustainability, efficiency, and yield. Through this system, this have observed significant reductions in water usage compared to traditional soil-based cultivation methods, as well as improved nutrient absorption by plants leading to accelerated growth rates and higher yields. Additionally, the controlled environment provided by hydroponic systems minimizes the risk of pests and diseases, contributing to healthier and more consistent herb production. This not only ensures a more reliable food supply but also reduces the need for pesticides and other harmful chemicals.

Furthermore, the scalability and flexibility of hydroponic systems make them suitable for various settings, from small-scale indoor herb gardens to large commercial operations. This versatility allows for the cultivation of fresh herbs year-round, regardless of climate or geographical limitations. The hydroponic herb system represents a sustainable and innovative approach to herb cultivation, offering numerous benefits for both producers and consumers alike. The proposed system helps farmers to remotely control the water to various fields based on type. This system provides a below cost easily control method using Bluetooth

6. FUTURE SCOPE

The proposed system is implemented with STM 32 controller which can be further modified with Raspberrypi microcontrollers like ARM, more sensor with STM technology and AI algorithm can be implemented in the future to achieve better productivity effective control of hydroponics fooder system. This extends watering time for plants, and provides ideal growth condition. It saves time and timer delay as per the environmental condition can be added for automatic watering. This system can be adjusted and modified according to the changing environment. This method allows food to be grown in areas that cannot support crops in the soil. It is environment friendly as it reduces soil erosion as well as air and water pollution.

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