RESEARCH ARTICLE

RESOURCE AND AREA MANAGEMENT WITH AUTOMATED OLERICULTURE NURSERY MONITORING SYSTEM.

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Manuscript Info

Abstract

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This paper is mainly intended for increasing the productivity and decreasing manpower in the agriculture sector by producing quality saplings in helical confined structure through the adoption of automation services. The idea of solving farmer's dependency on nursery for quality saplings has motivated us to move forward with it. Major part of the agriculture domain is Olericulture. Olericulture is the science of vegetable growing, dealing with the culture of non-woody plants for food. Considering tons of crop loss every year due to unhealthy growth of saplings and ever increasing mouth to feed, our solution to this problem is 'Resource and area management with automated Olericulture nursery monitoring system'. The key factors are automated temperature and humidity control and monitoring system and automated sprinkler system with the help of embedded technology. Natural resources such as solar power and rainwater are utilized for supplement power and water requirements.

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Introduction:-

India Ranks second worldwide in farm output. Agriculture and its allied sectors account for 13.7% of the GDP, about 50% of total workforce. The economic contribution of agriculture to India's GDP is steadily declining with the countries broad-based economic growth. Still agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. With increasing   population farmers play a significant role in to fulfil the food needs. To obtain rich and healthy crops with sufficiently high yield the crops has to be nurtured with extensive care at the very first stage. With the traditional way of growing crops by sowing the seeds in the field, the sapling undergo extreme temperature, humidity variation along with pest attacks, which hampers the healthy growth of crops. To overcome with this major problem, farmers use the conventional nursery methods or approach to nurseries.

Nursery is a method to grow saplings on the trays placed on the land in the controlled environment by maintaining the temperature and humidity using polyhouse technique. This method requires frequent monitoring of the saplings and manpower for its regular watering to avoid withering of the saplings. Nursery has provided good saplings to the farmers but its conventional way of working can be improved by making use of technology.

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Our system adds a creamy layer to the conventional methodology of nursery. With varying temperature and humidity requirements for different crops, the existingpolyhouse method does not provide flexibility. Our system uses a précised way of controlling the temperature and humidity by automating the process [1]. The nurseries make use of large lands which costs them, hiking up the price of each sapling. This issue can be overcome by our proposed helical system which is a combination of vertical and horizontal farming that takes helical structure for the trays to be placed. Manpower is required for timely watering of the saplings. To reduce this effort the system automatically waters the saplings at regular intervals [2]. The renewable source of energy is being utilized to fulfil the partial power requirements of the system by use of solar power. The inclusion of rainwater harvesting in the system provides supplementary water supply. GSM is used to update the user about the current happenings of the system [3]. The ability to monitor, evaluate the system's operations can provide enormous benefits to its productivity.

Literature Survey:-

Traditional farming requires intensive manpower for various farming activities such as watering the plants. Agriculture sector being the most important sector to mankind has not adopted automation completely. The reason being insufficient knowledge of the farmers on electronic and automation equipment and use of machineries throughout the year [4]. Traditional agricultural methods practiced by the local farmers are highly sustainable, although the all-inclusive cost is not cheap[5].

Nowa days farmers are keenly interested in making their work easier. Many of them are moving towards labour-saving automation devices to increase their yield which leads to profit. According to the recent survey many farmers are adopting automated machines in their farms so as to increase their yield by having minimum number of labours. When we are talking about the nurseries again the area is a major criteria and automating such large area is economically inefficient. With this problems we are proposing our system which is economically efficient which also saves the area for the farmer reducing the dependency over the private nurseries.

System design overview:-

Figure 1:-system Design.

The system has a hollow cuboidal structure including all the components. Water tank is placed above the structure to provide sufficient water pressure to the sprinklers. Surrounding the structure is the helical plate, which serves as platform for growth of the saplings.At the top, the system includes rain water harvester to direct the filtered water to the water tank. The exhaust fan and mist sprayer are placed at opposite corners of the structure to control the

temperature and humidity. A display terminal is included to showcase the temperature and humidity values to the user. The water pipe sprinkler system runs below each level of helical plate for time to time watering of saplings.The system contains protective net which protects the saplings from birds and insects.
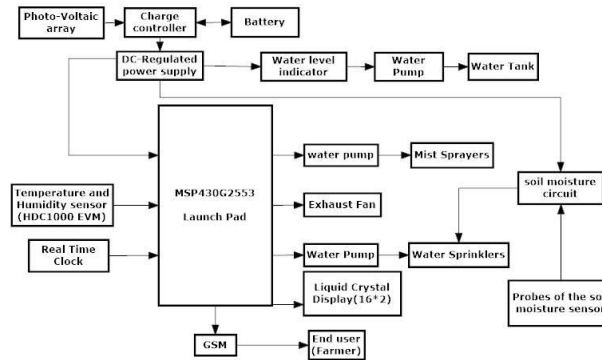
Hardware Design:-

Figure 2:- Block diagram.

The heart of the system is msp430g2XX microcontroller which is a 16 bit, 16 MHz mixed signal processor which is designed for low power consumption for embedded applications. The current drawn in idle mode can be less than 1micro ampere. This embedded micro controller is mainly used to process the data from the automation subsystems and give the corresponding control signals to the external peripherals. The microcontroller supports the following subsystems.

Temperature and humidity monitor and control system:This subsystem consists of a temperature and humidity sensor that gives real time values of theenvironmental temperature and humidity. These values are fed into the microcontroller. Thesevalues are compared with the threshold values and the exhaust and mist sprayers are controlled tomaintain temperature and humidity respectively.

Water Flow Control System:-
The water flow to the water tank from the reservoir is automatically controlled by means of analog circuitry. Two sensor electrodes are placed in the water tank to sense the water level based on which the turn on and turn off of the motor is controlled.

Sprinkler System:-
There is continuous pipe consisting of sprinklers which run underneath the plates to water the saplings at each level. The watering of the sapling is done on timely basis making use of real time clock.

GSM System:-
GSM is interfaced to update the user on the current happenings of the system such as ON and OFF of the sprinkler, temperature and humidity values indicated by the sensor. And also, the user controls the sprinkler by sending the control message through GSM.

Solar power System:-
The solar panels are placed at the top of the system at an appropriate angle to access the maximum sunrays in order to fulfil the partial power requirement of the system. The solar panel first sends the light to electrical converted signal to charge control circuit. Some amount of this charge is stored in the battery for later use and remaining charge is directly consumed by the system.

Soil moisture detector circuit:-
The water flow to the sprinkler from the water tank is automatically controlled by means of analog circuitry. Two sensor electrodes are placed in the soil to sense the soil moister based on which the turn on and turn off of the sprinkler is controlled.

Software Design:-
Few of the subsystems are programmed to work as required. The MSP430 is programmed to sense the signal from temperature and humidity sensor using I2Cprotocol.Making use of this protocol is advantageous as it reduces the number of pins, to be used on MSP430. The sensor is first initialised using its predefined address. The MSP430 next initialises the temperature and humidity sensing mode of the sensor , using its separate predefined address . The sensor senses the real time temperature and humidity values with a minute error of $0.2°$c and 1% respectively and sent to MSP430 in binary bits. Using appropriate algorithms these bits are converted to real time values. The microcontroller compares these values with the threshold value and by sending control signals it controls the ON and OFF of the exhaust fan and mist sprayers. Parallel these values are displayed on the display terminal.

RTC is interfaced and programmed with MSP430 to make use of its background running clock so as to send the signals to the sprinkler system to water the saplings on specific time.

The GSM is programmed using AT commands using MSP430. It is initialised to message mode. The status of the sprinkler is sent to the user.

Algorithm for temperature and humidity Control:-

Step 1: Start
Step 2: Initialize the sensor with its address.
Step 3: Initialize the temperature sensing mode with itsaddress.
Step 4: Initialize the humidity sensing mode with its address.
Step 5:Read the temperature and humidity values (in binary)
Step 6:Convert the values to real time values using conversion formula.
Step 7: Compare the converted values with threshold value.
Step 8: If temperature is greater than threshold value, turn on the exhaust fan.
Step 9: If humidity is below threshold value turn on the mist sprayers.
Step 10: Display the temperature and humidity values on the display terminal.
Step 11: Go to step 1.

Algorithm for sprinkler System:-

Step 1: Start
Step 2: Check and intimate the status of RTC
Step 3: If RTC is running, update it with the PC systems current time.
Step 4: Initialise the time at which the sprinkler should be turned on and off.
Step 5: At appropriate time turn the sprinkler on or off.
Step 6: Initialise the GSM to text mode.
Step 7: Initialise the GSM to send mode.
Step 8: Indicate the user's mobile number.
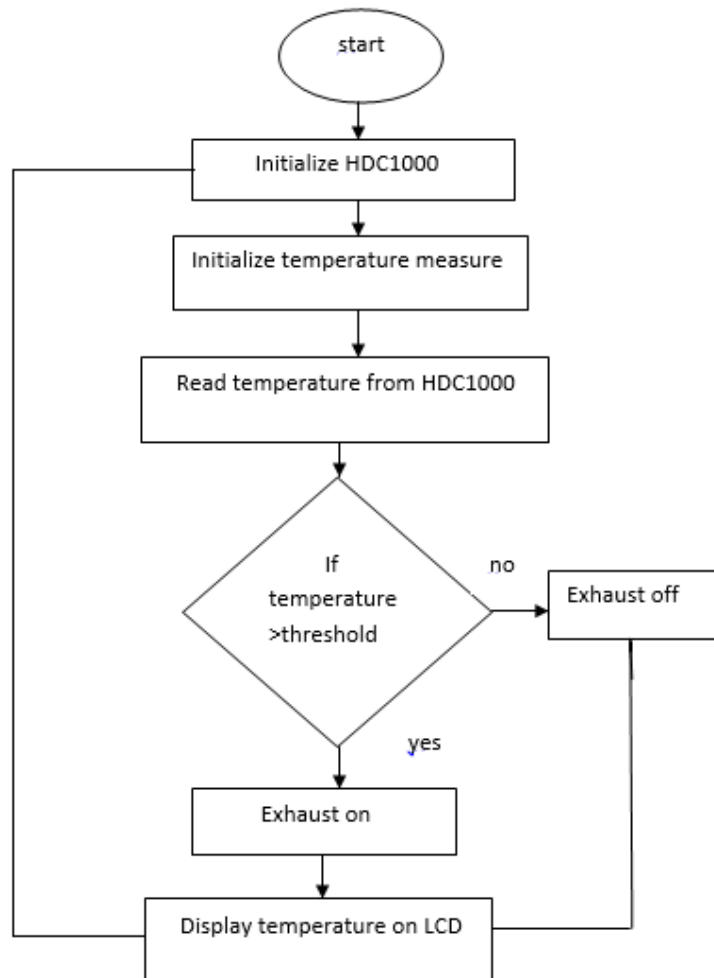Step 9: Send the message indicating the status of the sprinkler.
Step 10: Go to step 5.

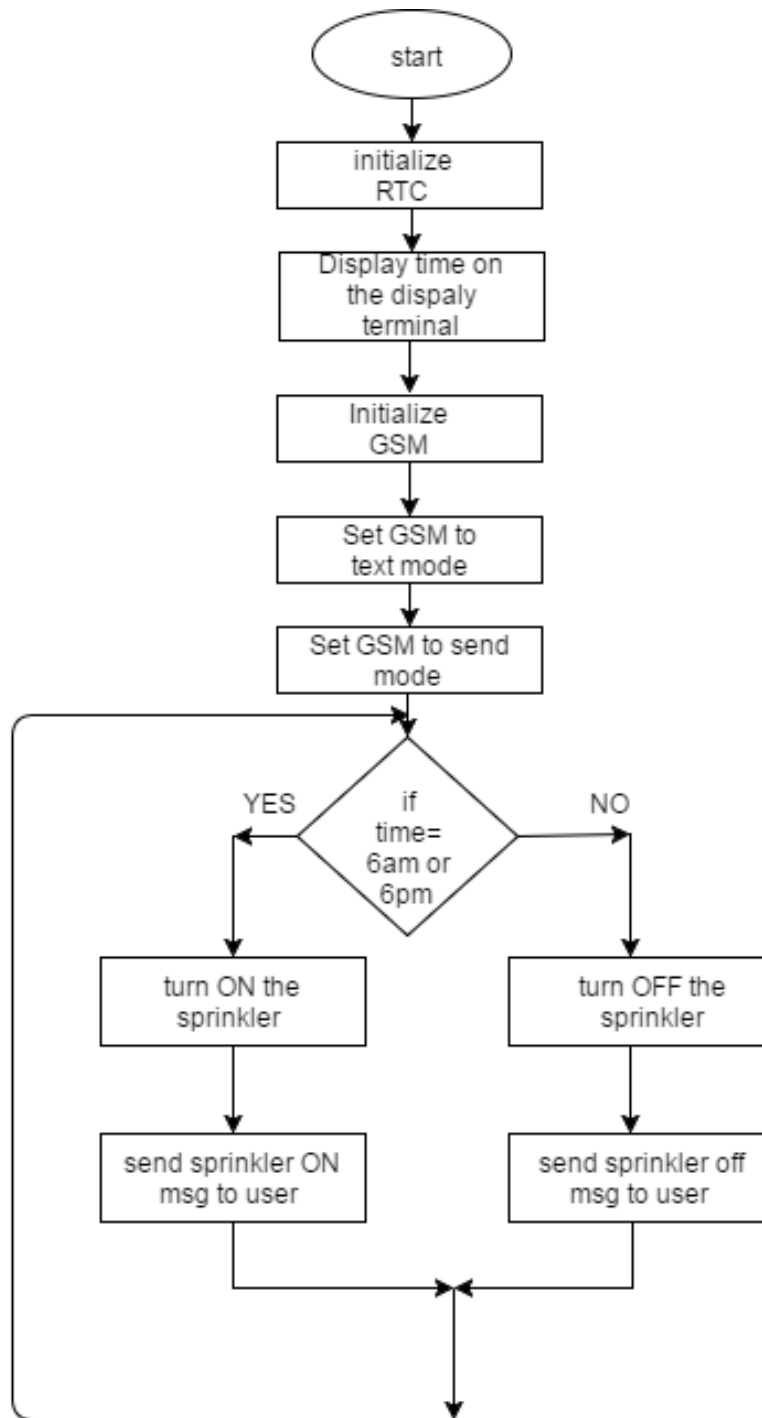**Figure3:-** Flow chart for temperature and humidity control.

Figure 4:-Flow chart for sprinkler system

Result:-

Helical farming system is a reformation to the conventional nursery methods. The following table is the comparison of our system with the existing methods.

Parameters	Helical farming	Conventional method
productivity	32 trays of sapling. (for the same area with four levels)	9 trays of sapling.
manpower	Less. (Required only for preparation of the trays and placing them on the plates.)	More. (Requiredfor preparation of trays, watering the sapling,switching on and off of water pump and exhaust.)
Rainwater harvester	Makes use of stored water during water crisis.	Does not include rainwater harvester.
Solar power system	Used to fulfil the power requirement partially.	Mostly not used.
Temperature and humidity control	Précised due to the use of automated electronics.	Not precisely controlled due to the use of shade nets.
Flexibility	The system uses screwing mechanism which gives an advantage to add on many levels with varying growth height of the saplings.	Irrespective of the growth height of the sapling the area consumed always remains constant.
Cost	The initial installation cost is comparativelyhigh but it cuts down the cost during the usage period. And also the labour cost is cut down.	Collective cost is high when compared.

Conclusions:-

In this paper, we presented the design and implementation of an automated energy efficient and water conserving microcontroller based helical farming system. Compared with conventional nursery method, our system is more advantageous in term of productivity, manpower, flexibility, cost and sustainable development making use of natural resources. Hence this system will give an extensive impact on the users. Our users are the people and the farmers who adopt nursery methods. The user at the beginning stage has to only initialise the system in terms of its software i.e. setting the time of watering the saplings, design i.e. the distance between each level depending on the sapling height growth, etc. After which the user gets the update about the happenings of the system to ensure its proper working.

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