

Controlling and Monitoring the Plant Growth Conditions using Embedded Systems

G.V. Sai Prasanna, G.Vijay Kumar

Abstract: *Recent technologies leads to the rapid development of the various innovations around the world. Every system is expected to be good working and cost effective. To reduce the manual involvement in agricultural fields ,our proposed system presents the embedded based alerting system which helps to find the condition of the plant by monitoring them in effective with good working condition and cost effectiveness. This optimized system can be useful to get to know the details of the plant and make the farming easy.*

Index Terms: *Agriculture ,Alerting, Embedded Systems, Low Cost, Monitoring.*

I. INTRODUCTION

In the present day world the role of the embedded systems is playing a prominent role in the society. Whatever the facilities we are equipped and provided for us with are nothing but the applications of embedded systems, Wireless Sensor Network (WSN) and Internet of Things (IoT). They are paving a way for the comfortable living style of environment for us and are enabling the smart communication methodology between the devices.

Among various sectors, Agriculture is one of the most important sectors in India. The majority of the population in India depends on this. The country's majority of the income and wealth from exporting the goods can be produced in this sector. But the climatic conditions in the country are not always favorable to the field workers as it's mainly a tropical country. The water scarcity should be observed which is the major crisis in India. The technology for the development of the various innovative designs are increasing steadily. Using those technologies we need to build up the systems which can be able to solve these peril. Many technologies like smart farming [1], drip irrigation, precision agriculture [2] have come into limelight to provide the solutions to these problems. The repetitiveness of the labor work which involves the continuous monitoring of the field day and night is a cumbersome task. But this has to be made simple by reducing the difficulty based on the today's world intellect. Every year the amount of the water wastage is more increasing and also the proper management of water usage is completely left unbothered.

According to recent statistics, the proper knowledge and awareness on the plant biology and the modern agriculture is necessary for the better understanding of the plant. Most of the water amount is going in vain during the watering of the plants. The main condition of the drip irrigation and other schemes is to make sure that the roots of the plant is watered and nourished. Seasonal maintenance and watering is an another important parameter for agriculture in India. The seasons in India are very tropical compared to the other countries, and also due to the global warming and other pollution factors , the rainfall range is very low. Hence we must take the best of the available water we have by some innovative methods which also must be cost effective.

Taking the present day issues of agriculture into consideration, we have proposed system which can be useful to share the update about the plant condition irrespective of the climatic conditions. The system can give us the alert based on the conditions of the plant such as temperature, humidity, pH levels, Light intensity and other conditions. Here the main objective is to reduce the energy consumption, cost and to increase the crop productivity by reducing the burden of manual involvement.

II. RELATED WORK

Ibrahim Mat et al.[3] used the method which makes the automated irrigation which helps in the less consumption of water. The main concentration of their method include the moisturization of the plants and to save the water content consumed by them. A. Baggio et al used mobile robots in agriculture . By arranging sensor nodes which measures humidity, soil nutrient amount, availability of insects and pests along with fruit's condition of ripeness within the area, Robots are used in this process for getting the data and reducing the workload of a farmer.[4].George Eldho John et al[5] used the sensor nodes in order to take the values of the soil moisture. The hardware implementation of their method includes MSR protocol and the range free localization technique is implemented in this process. Yassine Jiber et.al[6] introduced the cable free methodology of iFarm in the precision agriculture through their work. Richard Charles Andrew et. al[7] provided the smart farming techniques on the animal health as well as the plant monitoring through their IoT solutions. Lei Xiao et.al[8] proposed the new method involving WSN in agriculture to improve the lifetime, robustness of the network in the field.

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Prakashgoud Patil et.al[9] concentrated on the availability of the water level in soil as the main part and proposed an automated irrigation controller in their work.

III. FACTORS RESPONSIBLE FOR THE PLANT GROWTH:

A. Temperature:

Temperature plays a the major role in plant growth environment system. It helps in various stages such as photosynthesis, transpiration, flowering etc. Every plant has its own type of temperature limit and is not same for all plants. Every time the required level of temperature factor must be maintained, if we failed to so then some of the growth cells of the plant may not be nourished well and they may become less active. This leads to the damage of the growth function of the plant.

B. pH Level:

pH is nothing but the amount of hydrogen particles present in the material. The growth of the plants requires the particular method which helps them to get their nutrients. We can also give the fertilizers and manure for its good growth. The identification of pH of the plant is very necessary as it's useful in checking whether the soil [10] is in basic, acidic or neutral condition. Water is said to be having the neutral when pH level is 7, We have to consider this parameter to tell the soil condition [11] because some plants may require various types of soil for their growth and apparently it varies from plant to plant. If the field is grazed by the livestock, then there's a possibility of getting manure as their fertilizer. In such cases we need not add any extra fertilizers. In India the majority of the fertilizer can be obtained by the cattle naturally by their manure.

C. Light Intensity:

It may not seem to be, this factor also plays the very prominent role in plant growth. The light condition must be abundant for some plants especially potatoes and cabbages. In equatorial countries the abundant amount of sun light is produced and hence the agriculture sector is very rich in India. The light helps the plants for producing food, But on the contrary it also has some adverse effects like ,excessive amount of it also leads to the reduction of chlorophyll in plants which thereby leads to the water content reduction.

D. Moisture Level:

It gives the amount of water content present in the soil, the water is necessarily important and the level of water must be adequate amount and not more than that. The excess amount also leads to the improper nourishing and every part of the plant will not be able to get water.

IV. MATERIALS AND METHODOLOGY

A. Block Diagram:

The below shown figure is exhibiting the proposed model of ours which involves the system which is used to give the information of plant conditions such as temperature , soil moisture, pH level, light intensity. The entire system is interfaced to the raspberry pi model B and various sensors are fed to it in order to collect the sensed data and the buzzer alert, audio output indicator and the text messages are the outcomes.

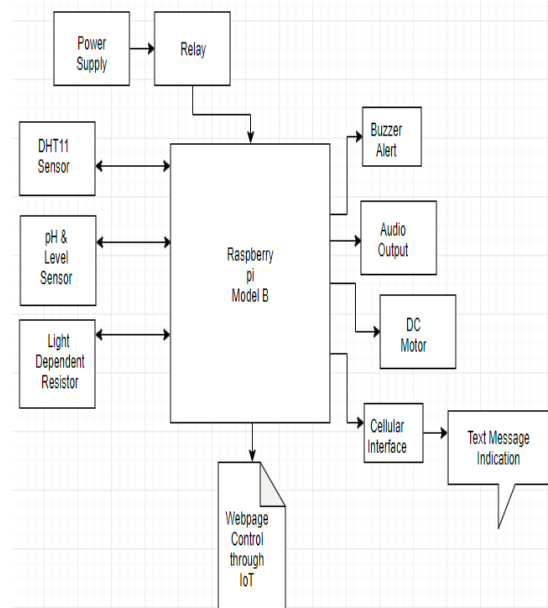


Fig 1: Block diagram of the proposed model.

B. Flow Chart representation of the proposed model:

The main concept of the proposed method is to detect the plant conditions depending upon the various parameters. When the operation of the system is performed the sensor detects each and every parameter and gives us the obtained value. The representation of the entire model can be seen in the flow chart described below:

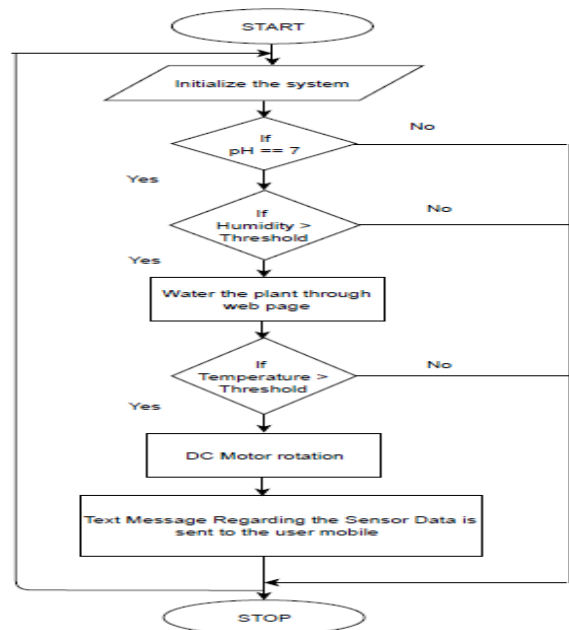


Fig 2. Flow Chart Of The Proposed Model

V. WORKING METHODOLOGY

The model is interfaced to the raspberry pi 3 board and various sensors are being connected to them. The threshold limit to temperature ,pH, Light intensity and Humidity are given.

The system consisting of the sensors collects the data, and the communication to the raspberry pi is done in serial mode by UART with the help of relay. The main principle of UART is to transmit and receive the information between sensors and raspberry pi. Serial communication is useful for the step by step observation of the process. pH value is taken from the pH sensor. pH condition of the soil can be examined to know the intensity of that soil and to check whether it's a fertilized soil or not. But if the readings are abnormal, then the artificial pesticide feeding must be reduced in order to protect the soil. Humidity factor can also vary depending on the weather conditions. If there is more humidity value, then we need not water the plant thereby reducing the water content. Here in this work the pH of the soil and water are observed. The temperature and humidity measurements are taken from DHT11 sensor. The limit to the temperature can be varied depending on the regional climatic condition. After initializing the setup, the system activates and the sensors collect the data and sends the information to R-Pi. The temperature sensor is given the threshold limit of 35, and if it exceeds the limit, the DC motor rotates for particular time and we can off it by webpage and voice indication is also alerted. Here motor of 60 rpm is used in this work. And if the temperature value doesn't exceed the limit, then the plant is said to be in a normal condition and we shall just receive the text message regarding the data. Light dependant resistor [12] is taken in order to measure light intensity. Light Dependant resistor value can be low during the night times and monsoon seasons. This helps to get the knowledge regarding the weather condition. If the light intensity level is not high then we need not water the plant. After initializing the system, the sensor values are collected in this process. If the temperature exceeds the given threshold the alerting systems such as audio indicator is activated along with DC water motor activation. The sensor values obtained here are in the digital units and we need to convert them in their concerned form of units. In order to support the disabled persons the audio indicators can be useful to share the information through voice and the alerts were also given to them. The blind or the disabled can gain much help in knowing the condition of their plants with the help of this indicator. After completing the entire process, the text message of plant condition will be sent to user mobile and the data is also stored in the webpage that we created.

VI. RESULTS AND DISCUSSION

The experimental setup showed below is the system proposed in this paper. The system is connected to the raspberry pi 3 Model B.



Fig 3: The overall hardware setup.

The above figure represents the hardware setup in which we have observed the pH of the impure soil water and also level of the water using level sensor. The readings of the temperature is automatically detected by dht11, and pH is detected by sensor which are obtained as follows:

Sl. No	Temperature (°C)	pH	Humidity (%)
1.	31	6	70
2.	30	5	80
3.	28	10	95

Table 1. The temperature and pH value identified



Fig 4: Monitoring the soil condition.

In the above picture, the soil pH level is observed in order to identify the soil fertility.

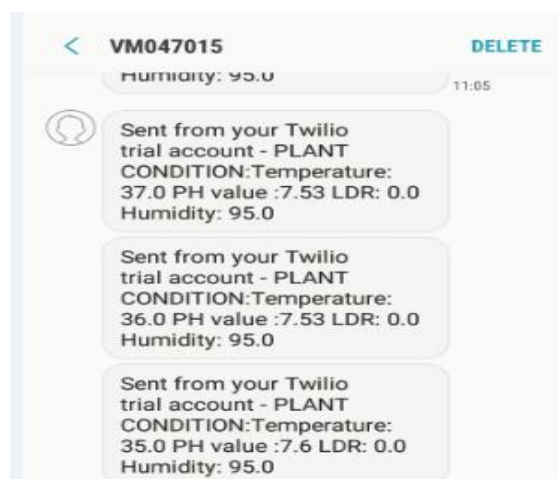


Fig 5: Text message of the plant condition to user mobile phone.

The details which are identified while the processing the system are being sent to the user mobile as a text message. The user gets the message regarding his plant status.

PRECISION FARMING MONITORING AND CONTROL

BUZZER ON BUZZER OFF MOTOR ON
MOTOR OFF

PLANT CONDITION:Temperature: 87.0 PH
value :37.76 LDR: 0.0 Humidity: 95.0 BUZZER
is OFF

Fig 6:Webpage Controlling of the system.

The above mentioned image is the web page monitoring of the system. The user can be able to operate it in mobile without manual involvement.

VII. CONCLUSION AND FUTURE SCOPE

Due to the increasing aging population, the managing of the system every time is very difficult. The model we presented helps to get to reduce the man labor and involvement and also same time the text message information helps in webpage controlling in user mobile resulting to the buzzer alert and automatic motor rotation. The work depicted here is the simple ,easy and low cost which also includes an additional feature i.e. audio indication, which is useful for the disabled. It's especially suitable to Indian climatic condition as it is a tropical one with more temperature records. We can further add more parameters according to one's need. Mainly ,including agricultural fields, the maintenance of animal husbandry is also an important factor. In future ,wireless technology can be used to this work in order to help to track the live monitoring of fields and cattle.

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