Arduino Uno and IoT Based Smart Indoor Garden System

Gopiya Naik S
Department of Electrical and Electronics Engineering
PES College of Engineering
Mandya, India

Aishwarya R, Chaithra. M.K, Pooja S,
Jayanth K Gowda
Department of Electrical and Electronics Engineering
PES College of Engineering
Mandya, India

Abstract - In the present-day-world, innovation is commanding characteristic things and people aren't in bond with nature. One fundamental issue in this aggregate issue is the inaccessibility of natural foods grown from the ground. In any event, when individuals want to develop natural vegetables, they are in the absence of room at their clogged habitations. At any event, growing in pots turns into a monotonous procedure because of the prerequisite of successive checking of the plants. Indoor Gardening is a convenient solution for this situation. This work presents the benefits and requirements of indoor gardening, and the existing technologies which help urban people practice the art of gardening within their household, office space, or any other closed landscapes, without access to direct sunlight or soil

The project describes the smart gardening system using the concept of arduino Uno and IoT. The project uses a Wi-Fi module (ESP8266-12) which connects the system to internet. This module controls a motor and two solenoid valves for supplying water to the field on the information obtained from a water level indicator and two soil moisture sensors. This whole system is monitored and controlled by BLYNK server (My BLYNK android App) through internet. The project also depicts the concept of Internet of Things (IoT).

Keywords - Indoor Garden, Automatic watering, Monitoring, Ardino Uno, IOT

I   INTRODUCTION

India is the country of village and agriculture plays an important role for development of country. In our country, agriculture depends on the monsoons which has insufficient source of water. So, the irrigation is used in agriculture field. In Irrigation system, depending up on the soil type, water is provided to plant. In agriculture, two things are very important, first to get information of about the fertility of soil and second to measure moisture content in soil. Nowadays, for irrigation, different techniques are available which are used to reduce the dependency of rain. And mostly this technique is driven by electrical power and on/off scheduling [1]. In this technique, water level indicator placed in water reservoir and soil moisture sensors are placed root zone of plant and near the module and gateway unit handles the sensor information and transmit data to the controller which in turns the control the flow of water through the valves. We all know that plants are very beneficial to all human beings in many aspects. Many people love to have plants in their backyard. But due to civilization and insufficiency of place, many people grow plants in mould, pot and placed on the windowsill. These plants are dependent on conventional breeding-watering and provide the right amount of sun to sustain life and growth. In our busy schedule, many time people forget to water and care the plants according to the climate. So, the plants suffer from many disorders and ultimately die.And in addition, the world's biggest problem in modern society is the shortage of water resource. It is very essential to utilize the water resource in a proper way [2]. Thus, a system is required to maintain the health of the plant in all climatic conditions using the artificial lighting and automatic watering system. First let's discuss about artificial lighting provided for the growth of plants. In outdoor cultures, sunlight provides energy (through photosynthesis) for photosynthetic organisms. They also use light quality to sense and respond to their environment. To increase the production capacity, controlled growing systems using artificial lighting have been taken into consideration. Recent development of light-emitting diode (LED) technologies presents an enormous potential for improving plant growth and making systems more sustainable [1]. LED can replace natural light to ensure the growth and development of photosynthetic organisms, and how changes in intensity and wavelength can manipulate the plant metabolism with the aim to produce functionalized foods. A small ventilation (small door/window) should be made for the circulation of oxygen. When it comes to the matter of watering, different plants need different amount of water. Here we water the plants automatically by using Arduino and Internet of things (IOT) [2].

II   LITERATURE REVIEW

The authors in [2], created automated plant watering system in order to replace manual activities and making gardener's work easy. They have used sprinklers, drip emitters or a combination of both can be used for watering plants. Microcontroller ATmega328 is used here. It is programmed to sense the moisture level of plant if there is a requirement of water then the water is poured using sprinkler or drip emitter. System is designed to determine both its current state and it reminds user to add water to the tank. All this is notified through the mobile application. In addition to automated plant watering system, we are providing artificial light as per the plants requirement for photosynthesis process. Here we will be using various colour LEDs in order to provide light for plants.

In [3], discussed about the potentials of how the IOT technology can be linked to indoor gardening activities as a smart system. This system does not just provide easiness to

gardening, but also facilitates a new culture where people desire a quality of life and wellbeing. There are already a number of automated indoor gardening systems, but there is still big room for improvement with IOT technology. This paper proposes a possible smart indoor gardening system to cope with the issues. They have explained about the potentials and barriers of indoor gardening management and attempt to propose an optimal model for an indoor gardening system based on IOT in order to make gardening easy. Here we provide artificial light for photosynthesis process and automated water supply to the plants. And we develop a Wi-Fi module where we will get notifications in our mobile phone regarding the watering of plants.

In paper [4], presents the benefits and requirements of indoor gardening and the existing technologies which help urban people grow the plants within their house without access to direct sunlight or soil. The indoor gardening may be compartment planting or aquaculture planting. The strategies for cultivating expect access to the availability to the availability of sunlight, monitoring of the level of water, etc. This paper reviews the benefits of indoor gardening and the necessary conditions to ensure the health of the plants. These systems provide a good way to achieve the dream of including a garden in our busy urban lifestyle. Along with achieving the dream of including a garden in urban lifestyle, we are improving the indoor gardening technology by monitoring it from various places. Even in our absence we can control and monitor the watering of plants using mobile phones.

Due to shortage of land for agriculture, indoor gardening will be the best alternative for cultivation. But light is one of important parts of plant life. Here the artificial light is provided for the plants. Three different LED color lights, 18W are used. In this study, the height or growth of the salad plant was taken for 6 weeks period. The height of the salad plant in the red lamp is high i.e., 10.9cm, 7.41cm in blue, 7.6cm in white and 5.23cm in yellow light. It shows different color lights create an impact on the height growth of a plant. The LED light produces the lowest heat thus it reduces the release carbon dioxide into environment. This can be used in agricultural related activities that do not have large area for cultivation [5]. We can try this artificial light system for different plants as per their requirements and also providing automated water supply to the plants by controlling and monitoring the system through mobile phones.

Air pollution is one of the health problems faced by urban people. In this study, with nine 'indoor plant' species, and field studies in 60 offices, show that potted plants can reliably reduce indoor pollutants. This study shows that potted plant microcosm represents an innovative technology for solving indoor air pollution and can greatly improve IAQ by removing many major pollutants. To ensure the sustainability of the urban environment, satisfying the social and economic considerations, it is expected that indoor plants will become standard technology for improving IAQ [6]. Here we can implement automatic plant watering system and artificial light system in indoor gardening where most of the urban people

will not be having time to water the plants and light can also be provided artificially by controlling and monitoring the system through mobile applications. The study in [7], states that plants indoors have many benefits. They contribute to cleaner, healthier air for us to breathe, make surrounding more pleasant and make feel calmer. It is associated with reduced stress, increased pain tolerance. Plants have intangible positive effect on us. This indoor gardening can also be done by automatic plant watering and artificial lighting system which will be very useful in urban areas. The study [8] shows that, numbers of plants are being destroyed each and every day for urbanization process. The number of plantings made is also reduced. Apart from these things more plants die due to lack of maintenance. IoT allows objects to be sensed and controlled remotely across existing network infrastructure. Due to scarcity of water, there is an urgent need to irrigate more efficiently in order to optimize water use. The sensors gather and analyse data about changing weather, soil moisture, and humidity conditions. This can be controlled through mobile application using IOT. In addition to that we can provide artificial lighting to plants as per their requirements using LED. The study in [9], shows that most of the people love to grow plants at home, but due to their work schedule they very often take care of plants. Smart monitoring of the plant growth by modernizing the current traditional methods of gardening can be done. Internet of things (IoT) provides various applications for crop growth and monitoring the growth conditions. They have used moisture sensor and temperature sensor to maintain suitable moisture level and temperature. This paper works for the crop development at low quantity water consumption by providing an automatic watering system to the user. In addition to this we can implement artificial lighting to the plants with monitoring and controlling through mobile application. In [10], they have created an automatic plant watering system. This system uses Arduino UNO board, which consists of ATmega328 microcontroller and programmed to sense the moisture level of plants and supply the water if required. We can provide artificial lighting to plants using LED and can control and monitored through mobile application.

A Gaps Identified

Earlier they have done experiments and project on indoor gardening where they have implemented automatic watering system. One research has been done on providing artificial lighting to plants in order to study how different color lights create an impact on the height of the growth of a plant. Here we have combined both the techniques of artificial lighting and automatic watering system. In addition to this, we have used different sensors like moisture sensor to detect the moisture content of the soil, temperature and humidity sensor, light detecting sensor, and pollutant sensor which measures the carbon dioxide concentration. These readings will be displayed in LCD and as per the readings the system will work. There will be a specified range for each factor like temperature, humidity, light intensity and the moisture level. If the range reaches less than the threshold value or if it exceeds the threshold value then the system will operate accordingly.

We have used ESP8266 Wi-Fi network solution that can carry software application. We have used concept of IOT for monitoring and controlling the system using a public server called BLYNK server. It uses an android application called MY BLYNK where we will get a notification to our mobile phone about the functioning of a system.

B   Objectives

For continuously increasing demand and decrease in supply of food necessities, it's important to rapid improvement in production of food technology. Agriculture is only the source to provide this. This is the important factor in human societies to growing and dynamic demand in food production. Agriculture plays the important role in the economy and development, like India. Due to lack of water and scarcity of land water result the decreasing volume of water on earth, the farmer use irrigation. Irrigation may be defined as the science of artificial application of water to the land or soil that means depending on the soil type, plant are to be provided with water. The objectives of the proposed work are: Automatic watering to the plants and user notifications. Detect moisture content in the soil using moisture sensor. To identify the influence of different light shades and plant growth performance according to different light sources towards plant growth. To provide an innovative indoor plant design that allows people to grow plants without sun light. To work on increasing the oxygen level and to get fresh air by growing plants indoor.

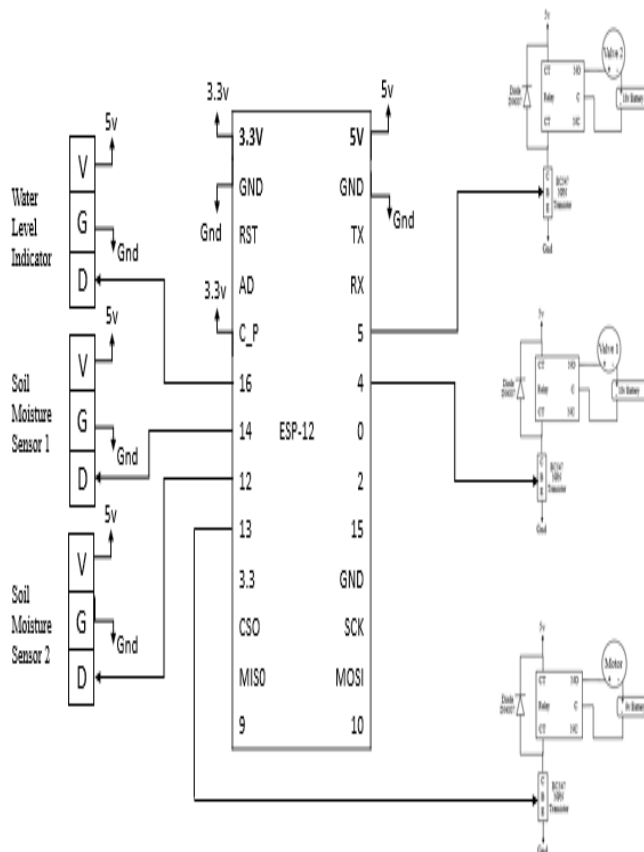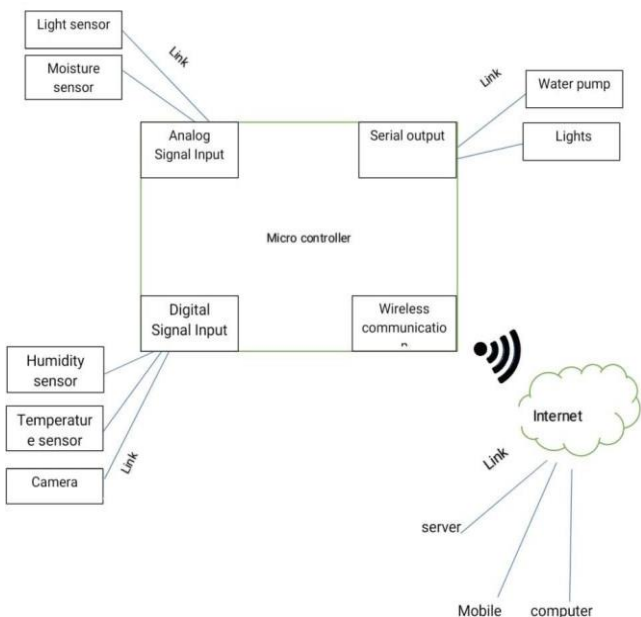### III   PROPOSED METHODOLOGY

Fig. 1: Block diagram of the proposed methodology

FIG. 2: CIRCUIT DIAGRAM

A   Circuit Connection Procedure

Step 1: Make the connection in bread-board as shown in figure 2 and verify results.

Step 2: Once results are confirmed, make a PCB layout using software Express PCB.

Step 3: Print the PCB layout on a copper plate.

Step 4: Itching: Immerse the printed PCB copper plate in a copper sulphate solution until all copper oxidizes except PCB traces. Then, wash with petrol to remove printed carbon.

Step 5: Place the components and carefully solder them.

Step 6: Make the complete connections, i.e., connect the water level indicator, soil moisture sensors, and submersible motor pump and solenoid valves.

Step 7: Connect the power supplies to output ends of relay switches as mentioned in the circuit diagram. 9V to motor pump, 18V to both valves. Connect the power

supplies to PCB board 5V, 3.3V and ground from Arduino board.

B   Physical Connections

Physical connections include the placing the sensors and actuators in small model ofagriculture field and includes proper connections. Detail is given below:

- The field includes two Regions: 1, 2 and a water reservoir.
- Submerse the submersible motor pump in the reservoir.
- Place the valve 1 in Region1.
- Place the valve 2 in Region2.
- Make proper pipeline connections from motor pump to the valves.
- Extend the pipeline connection to respective fields to supply water.
- Make some arrangements to supply the water like making the holes to pipes.
- Place the water level indicator in the water reservoir.
- Place the soil moisture sensor 1 in region 1 near the roots of the plants.
- Place the soil moisture sensor 2 in region 2 near the roots of the plants. Give all required supply voltages.

C   WORKING

Wi-Fi module has to connect the internet by an internet service provider like mobile hotspot, Wi-Fi router. Firstly module checks status of water level indicator, if water is present then it proceeds otherwise it terminates. If water is present, then it checks status of soil moisture sensor 1, If Region 1 is wet, motor will be off. If Region 1 is dry, valve 1 will open and motor will be on for 10 seconds. If Region 1 is humid, valve 1 will open and motor will be on for 5 seconds. During this, valve 2 will remain closed. Once again module checks status of water level indicator, if water is present then it proceeds otherwise it terminates. If water is present, then it checks status of soil moisture sensor 2, If Region 2 is wet, motor will be off. If Region 2 is dry, valve 2 will open and motor will be on for 10 seconds. If Region 2 is humid, valve 2 will open and motor will be on for 5 seconds. During this, valve 1 will remain closed. The System is usually OFF state. It is possible to get STATUS of the field. It is possible to make System ON whenever required. Once System is ON, it will check the status and supply the water one time only. Then again System is OFF. It is possible to make System OFF. But usually, System is always in OFF condition.

LED light source is used to provide artificial light for the photosynthesis process. Light sensor will detect the light intensity. There will be a specified threshold value of light intensity. If the value is less than that of specified threshold value the system will get notifications and the light source will be turned ON and if it exceeds the threshold value then it will be turned off.

There will be a specified threshold range for the temperature and humidity for the proper and healthy growth of plants. The value of temperature should lie between the specified ranges of 15 to 45 deg Celsius for plants to grow.

IV   RESULTS AND DISCUSSIONS

The outcomes of the work are:

- ❖ They overcome the spacing problems faced by urban peoples.
- ❖ Minimal waste of water due to apply of automatic watering system.
- ❖ Growing plants in house will drastically improve the quality of air we breathe, make surrounding more pleasant and calm.
- ❖ Moisture content of the soil, temperature, humidity, light and carbon dioxide level is sensed using different sensors.
- ❖ Water pumping motor turned on or off automatically using relay.
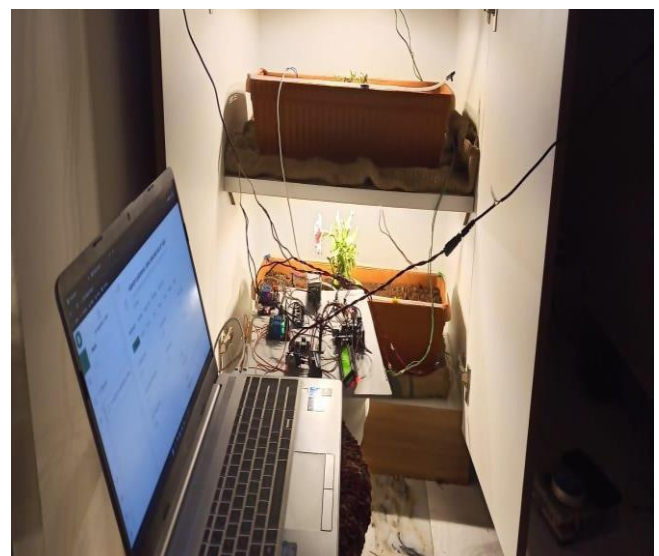- ❖ This system can be controlled and monitored through mobile application.

Fig. 3: Practical setup of the proposed system

Fig. 4: Plants grown with artificial lighting and automatic watering system

V   CONCLUSION

Nowadays, there is a huge scarcity of water especially for the agricultural purpose. Hence this technology will be very useful in reducing wastage of water as we are using an automatic watering technique. People living in urban areas like to grow plants in their house but due to busy schedule they can't able to take care of the plants hence this method will be very useful. Here we have used a modern technology IoT, which can also be used for other home automation. They also use light quality to sense and respond to their environment. To increase the production capacity, controlled growing systems using artificial lighting have been taken into consideration. This technology can also be implemented in agricultural field. People living in urban areas will prefer this technique as it is very useful in their busy schedule. This mainly helps in increasing the oxygen level and to get fresh air because air pollution is the major problem we are facing in urban areas.

VI   ACKNOWLEDGMENT

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