

IOT BASED AUTOMATED HORTICULTURE SYSTEM FOR FARMERS

A Project Report Phase – II

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Engineering degree in Electronics and Communication Engineering

by

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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade “A” by NAAC
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **SHAHUKARI HEMANTH (39130413)** and **SHAIK AZMATHULLA (39130414)** who carried out the project entitled "**IOT BASED AUTOMATED HORTICULTURE SYSTEM FOR FARMERS**" under my supervision from November 2022 to April 2023

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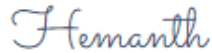
DECLARATION

We , **SHAHUKARI HEMANTH (39130413)** and **SHAIK AZMATHULLA (39130414)** hereby declare that the project report entitled “**IOT BASED AUTOMATED HORTICULTURE SYSTEM FOR FARMERS**” done by us under the guidance of **DR.V.BALAMURUGAN**, Associate professor, Department of Electronics and Communication Engineering, SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI, is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

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SIGNATURE OF THE CANDIDATES

1) 

2) 

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ABSTRACT

Smart horticulture is an emerging concept because IoT sensors are capable of providing information about horticulture fields and then acting based on user input. It is proposed to develop a Smart horticulture System that uses the advantages of cutting-edge technologies such as Arduino, IoT, and Wireless Sensor Network. The paper aims at making use of evolving technology i.e IoT and smart horticulture using automation.

Monitoring environmental conditions are the major factor to improve the yield of efficient crops. The feature of this paper includes the development of a system that can monitor temperature, humidity, moisture, and even the movement of animals that may destroy the crops in agricultural fields through sensors using the Arduino board. In case of any discrepancy send an SMS notification as well as a notification on the application developed for the same to the farmer's smartphone using Wi-Fi/3G/4G. The system has a duplex communication link based on a cellular Internet interface that allows for data inspection and irrigation scheduling to be programmed through an android application

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CHAPTER 1

INTRODUCTION

India has horticulture as its primary occupation. According to IBEF (India Brand Equity Foundation), 58% of the people living in rural areas in India are dependent on horticulture. As per the Central Statistics Office 2nd advised estimate, the contribution of horticulture to the Gross Value Addition (India) is estimated to be roughly around 8% which is a very significant contribution. Under such a scenario, the usage of water especially the freshwater resource by horticulture will be enormous and according to the current market surveys it is estimated that horticulture uses 85% of available freshwater resources worldwide, and this percentage will continue to be dominant because of population growth and increased food demand. India has horticulture as its primary occupation.

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Internet of Things (IoT) technology has brought a revolution to each and every field of common man's life by making everything smart and intelligent. IoT refers to a network of things that make a

self-configuring network. The development of Intelligent Smart Farming IoT-based devices is day by day turning the face of agriculture production by not only enhancing it but also making it cost-effective and reducing wastage. The aim/objective of this report is to propose IoT based Smart Farming System assisting farmers in getting Live Data (Temperature, Soil Moisture) for efficient environment monitoring which will enable them to increase their overall yield and quality of products. The IoT-based Smart Farming System being proposed via this report is integrated with Arduino Technology mixed with different Sensors and a Wi-Fi module producing a live data feed that can be obtained online from Thingspeak.com. The product being proposed is tested on Live Agriculture Fields giving high accuracy of over 98% in data feeds.

1.1 INTERNET OF THINGS:

Internet of Things (IoT) is a concept where each device is assigned to an IP address and through that IP address, anyone makes that device identifiable on the internet. The mechanical and digital machines are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. Basically, it started as the “Internet of Computers.” The recent developments in technology that permit the use of wireless controlling environments like Bluetooth and Wi-Fi have enabled different devices to have the capability of connecting with each other. Using a WIFI shield to act as a Micro web server for the Arduino eliminates the need for wired connections between the Arduino board and computer which reduces cost and enables it to work as a standalone device. The Wi-Fi shield needs a connection to the internet from a wireless router or wireless hotspot and this would act as the gateway for the Arduino to communicate with the internet. With this in mind, an internet-based home

automation system for remote control and observing the status of home appliances is designed.

1.2 BACKGROUND:

The concept of “Home Automation” has been in existence for several years. “Smart Home”, and “Intelligent Home” are terms that followed and is been used to introduce the concept of networking appliances within the house. Home Automation Systems (HASs) includes centralized control and distance status monitoring of lighting, security system, and other appliances and systems within a house. Home automation systems enable energy efficiency, improve the security systems, and certainly the comfort and ease of users. In the present emerging market, the home automation system is gaining popularity and has attracted the interest of many users. Our system comes with its own challenges. Mainly being, in the present day, end-users especially the elderly and disabled, even though hugely benefited, aren’t seen to accept the system due to the complexity and cost factors.

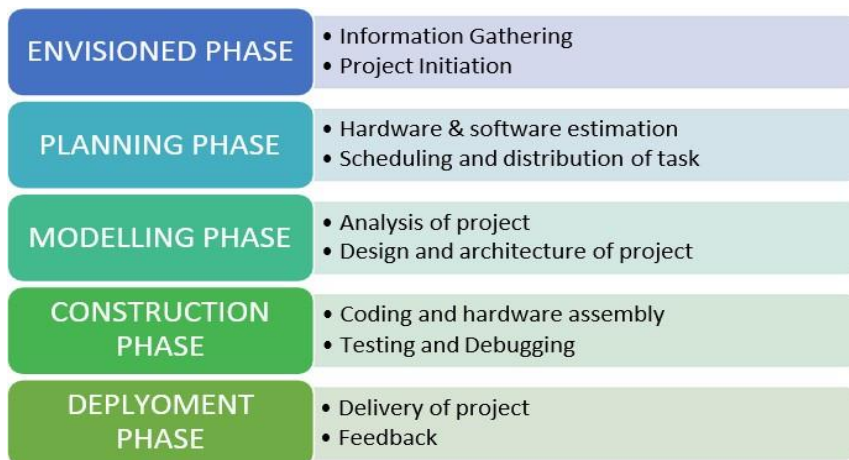


Fig: 1.1 Model of Phases in Project Management

1.3 SCOPE OF THE PROJECT:

Feasible expansion of irrigated horticulture will be able to accommodate only a portion of this increased demand, and the rest must come from an increase in the productivity of rain-fed horticulture. In the absence of coordinated planning and international cooperation at an unprecedented scale, the next half century will be plagued by a host of severe water-related problems, threatening the wellbeing of many terrestrial ecosystems and drastically impairing human health, particularly in the poorest regions of the world. A smart and intelligent horticulture system that can help the farmer to utilize the water level sensibly and also take care of other discrepancy factors like unrequired animal entry into the fields are discussed. The system consists of a microcontroller and sensors like moisture, temperature, humidity, motion, etc.

The aim is to design a prototype that establishes wireless remote control over a network of home appliances. The application is designed to run on an android device providing features like switch-mode control, voice command control, and a provision to view the status of the devices on the application itself. Considering its wide range of applications, the following are the scope of this prototype. The system can be implemented in homes, small offices, and malls as well, being in charge of control of the electrical appliances. For remote access to appliances on the internet or intranet. The appliances in the above-mentioned environment can be controlled intra-network or can be accessed via the internet. The development of a technology-friendly environment. The system incorporates the use of technology and making SAS. By the use of day-to-day gadgets, we can utilize them from a different perspective.

1.4 HORTICULTURE

This is the art of cultivating plants in gardens to produce food and medicinal ingredients, or for comfort and ornamental purposes. Horticulturists are agriculturists who grow flowers, fruits, nuts, vegetables, and herbs, as well as ornamental trees and lawns study and practice of horticulture have been traced back thousands of years. Horticulture contributed to the transition from nomadic human communities to sedentary, or semi- sedentary, horticultural communities. Horticulture is divided into several categories which focus on the cultivation and processing of different types of plants and food items for specific purposes. In order to conserve the science of horticulture, multiple organizations worldwide educate, encourage, and promote the advancement of horticulture. There are various organizations worldwide that focus on promoting and encouraging research and education in all branches of horticultural science; such organizations include the International Society for Horticultural Science and the American Society of Horticultural Science. In the United Kingdom, there are two main horticulture societies. The Ancient Society of York Florists is the oldest horticultural society in the world and was founded in 1768; this organization continues to host four horticultural shows annually in York, UK. Additionally, The Royal Horticultural Society, established in 1804, is a charity in the United Kingdom that leads in the encouragement world-class gardens and shows. The Chartered Institute of Horticulture (CIH) is the professional body that represents horticulturists in Great Britain and Ireland^[14] while also having an international branch for members outside of these islands. The Australian Society of Horticultural Science was established in 1990 as a professional society to promote and enhance Australian horticultural science and industry.

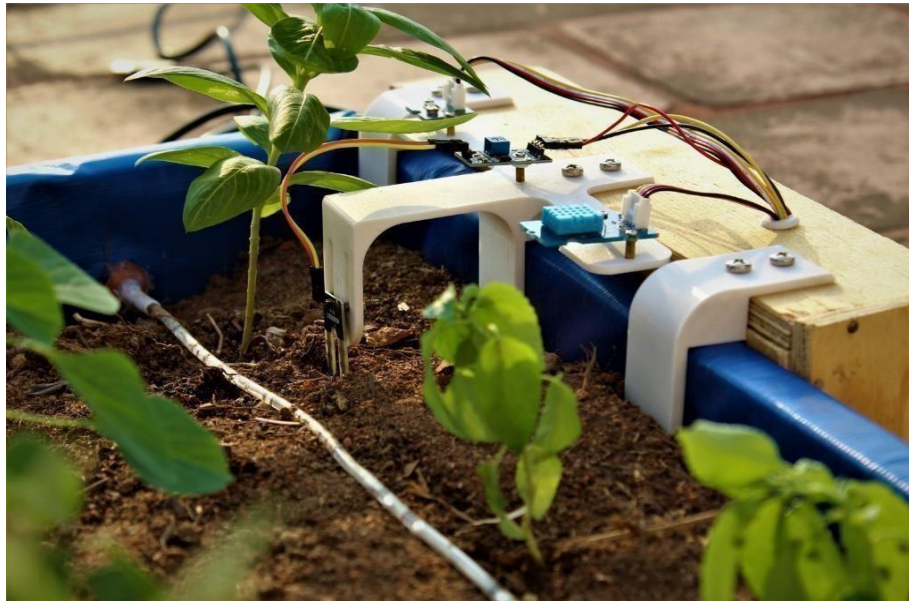


Fig :1.2 Model of the Equipment

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Finally, the New Zealand Horticulture Institute is another known horticultural organization. In India, the Horticultural Society of India (now Indian Academy of Horticultural Sciences) is the oldest society which was established in 1941 at Lyallpur, Punjab (now in Pakistan) but was later shifted to Delhi in 1949. Another notable organization in operation since 2005 is the Society for Promotion of Horticulture based at Bengaluru. Both these societies publish scholarly journals viz Indian Journal of Horticulture and Journal of Horticultural Sciences for the advancement of horticultural sciences. The National Junior Horticultural Association (NJHA) was established in 1934 and was the first organization in the world dedicated solely to youth and horticulture. NJHA programs are designed to help young people obtain a basic understanding of horticulture and develop skills in this ever-expanding art and science. The Global Horticulture Initiative fosters partnerships and collective action among different take holders in horticulture.



Fig: 1.3 Key Factors Under Considerations

This organization has a special focus on horticulture for development (H4D), which involves using horticulture to reduce poverty and improve nutrition worldwide. Global Posts organized in a consortium of national and international organizations which collaborate in research, training, and technology-generating activities designed to meet mutually agreed-upon sc. GlobalPost is a non-profit organization registered in Belgium.

1.5 Industrial Automation

For a higher return on investment, this field requires both fast developments and quality products. This vitality thus coined the term IIOT. This whole schematic is re-engineered by IoT applications. Following are the domains of IoT applications in industrial automation

- 1) Factory Digitalization
- 2) Product flow Monitoring
- 3) Inventory Management
- 4) Safety and Security
- 5) Quality Control
- 6) Packaging optimization
- 7) Logistics and Supply Chain Optimization

Government and Safety

IoT applied to government and safety allows improved law enforcement, defense, city planning, and economic management. The technology fills in the current gaps, corrects many current flaws, and expands the reach of these efforts. For example, IoT can help city planners have a clearer view of the impact of their design, and governments have a better idea of the local economy.

IoT Technologies and Safety:

Several communication protocols and technologies cater to and meet the specific functional requirements of the IoT system.

- A. Bluetooth
- B. Zigbee
- C. Z-Wave
- D. Wi-Fi
- E. Cellular
- F. NFC
- G. LoRaWAN

Bluetooth

Bluetooth is a short-range IoT communication protocol/technology that is profound in many consumers product markets and computing. It is expected to be key for wearable products, in particular, again connecting to the IoT albeit probably via a smartphone in many cases. The new Bluetooth Low-Energy (BLE) – or Bluetooth Smart, as it is now branded – is a significant protocol for IoT applications. Importantly, while it offers a similar range to Bluetooth it has been designed to offer significantly reduced power consumption.

Zigbee

ZigBee is similar to Bluetooth and is majorly used in industrial settings. It has some significant advantages in complex systems offering low-power operation, high security, robustness, and high and is well-positioned to take advantage of wireless control and sensor networks in IoT applications. The latest version of ZigBee is the recently launched 3.0, which is essentially the unification of the various ZigBee wireless standards into a single standard.

Z-Wave

Z-Wave is a low-power RF communications IoT technology that is primarily designed for home automation for products such as lamp controllers and sensors among many other devices. A Z-Wave uses a simpler protocol than some others, which can enable faster and

simpler development, but the only maker of chips is Sigma Designs compared to multiple sources for other wireless technologies such as ZigBee and others.

Wi-Fi

Wi-Fi connectivity is one of the most popular IoT communication protocols, often an obvious choice for many developers, especially given the availability of Wi-Fi within the home environment within LANs. There is a wide existing infrastructure as well as offering fast of data transfer and the ability to handle high quantities of data. Currently, the most common Wi-Fi standard used in homes and many businesses is 802.11n, which offers a range of hundreds of megabits per second, which is fine for file transfers but maybe too power-consuming for many IoT applications.

Cellular

Any IoT application that requires operation over long distances can take advantage of GSM/3G/4G cellular communication capabilities. While cellular is clearly capable of sending high quantities of data, especially for 4G, the cost and also power consumption will be too high for many applications. But it can be ideal for sensor-based low-bandwidth-data projects that will send very low amounts of data over the Internet.

NFC

NFC (Near Field Communication) is an IoT technology. It enables simple and safe communications between electronic devices, specifically smartphones, allowing consumers to perform transactions in which one does not have to be physically present. It helps the user to access digital content and connect electronic devices. Essentially it extends the capability of contactless card technology and enables devices to share information

LoRaWAN

LoRaWAN is one of popular IOT Technology, targets wide-area network (WAN) applications. The LoRaWAN design to provide low-power WANs with features specifically needed to support low-cost mobile secure communication in IOT, smart city, and industrial applications. Specifically meets requirements for low-power consumption and supports large networks with millions and millions of devices, data rates range from 0.3 kbps to 50 kbps.

1.6 IoT Software:

A. Data Collection

B. Device Integration

C. Real-Time Analytics

D. Application and Process Extension

Data Collection

This software manages sensing, measurements, light data filtering, light data security, and aggregation of data. It uses certain protocols to aid sensors in connecting with real-time, machine-to-machine networks. Then it collects data from multiple devices and distributes it in accordance with settings. It also works in reverse by distributing data over devices. The system eventually transmits all collected data to a central server.

Device Integration

Software supporting integration binds (dependent relationships) all system devices to create the body of the IoT system. It ensures the necessary cooperation and stable networking between devices. These applications are the defining software technology of

the IoT network because, without them, it is not an IoT system. They manage the various applications, protocols, and limitations of each device to allow communication.

Real-Time Analysis

These applications take data or input from various devices and convert it into feasible actions or clear patterns for human analysis. They analyze information based on various settings and designs in order to perform automation-related tasks or provide the data required by the industry.

Application and Process Extension

These applications extend the reach of existing systems and software to allow a wider, more effective system. They integrate predefined devices for specific purposes such as allowing certain mobile devices or engineering instruments access. It supports improved productivity and more accurate data collection.

1.7 IOT IN HORTICULTURE

India is the crop growing based country. Our ancient public entirely depended on the farming realizing. Agriculture is a cause of living of mainstream Indians and has great control on the economy of the country. In dry zones or in situation of lacking rainfall, irrigation comes to be difficult. So, it wants to be involuntary for correct produce and measured at all for farmer protection. Horticulture is a sub-sector of agriculture that plays a significant role in the economy, human nutrition, gender mainstreaming, and employment. Horticultural commodities include fruits, vegetables, flowers, spices, and condiments, which have grown steadily and turned into a major segment in agricultural trade. The objective of the Horticulture system is to keep a measure on food security and the aim of the automatic irrigation control system is to minimize the efforts of the

human operator (gardener) in Horticulture activities. Over the years, monitoring soil moisture levels of farmlands have been performed manually.

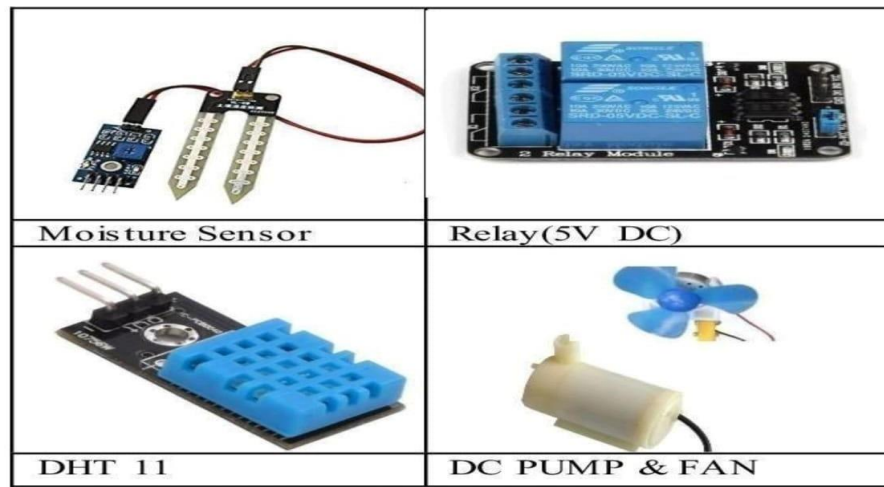


Fig:1.4 Equipments of the project

1.8 Components Implemented for IoT Horticulture Model

This is often time-consuming and inefficient, necessitating a solution that is efficient in controlling and monitoring soil moisture conditions. This work, therefore, proposes an Internet of Things IoT- based soil moisture monitor that observes soil moisture level using an ESP32 consisting an of inbuilt Wi-Fi module to send data from the board to the user's cell phone or laptop. The soil moisture monitor works by observing the water level of the soil and alerts the farmer when the predefined threshold rate of the moisture sensor goes above or below, thus indicating overwatering or underwatering. This control system is built around Arduino programmed using embedded C language. This process also involves sending data from the sensor.

proposed soil moisture monitor using Thing speak shows that the system is dynamic and efficient as it ensures water is not wasted. It is also cost effective as it eliminates the huge budget for hiring farm workers. Horticulture commodities; e.g., especially vegetables such as red chili, red onion, tomatoes, and potatoes are essential agricultural products in the food supply needs in Indonesia.

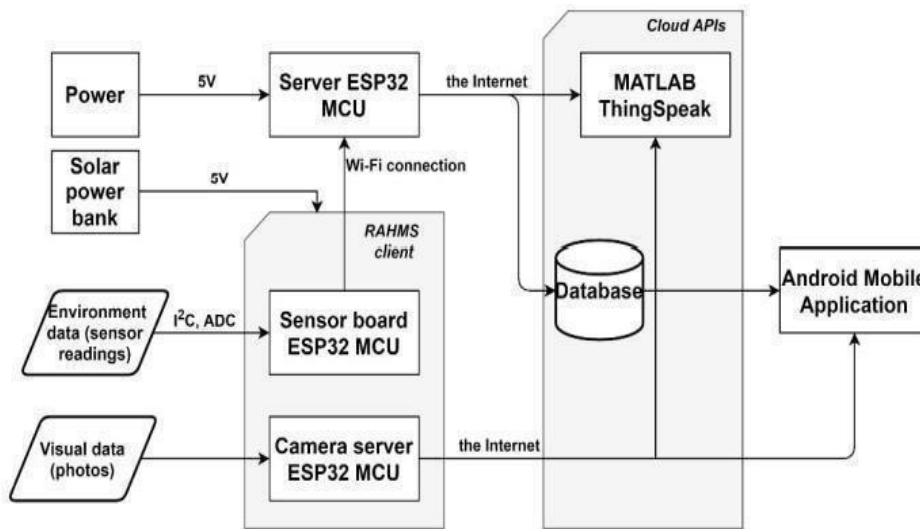


Fig: 1.5 PROPOSED SYSTEM BLOCK DIAGRAM

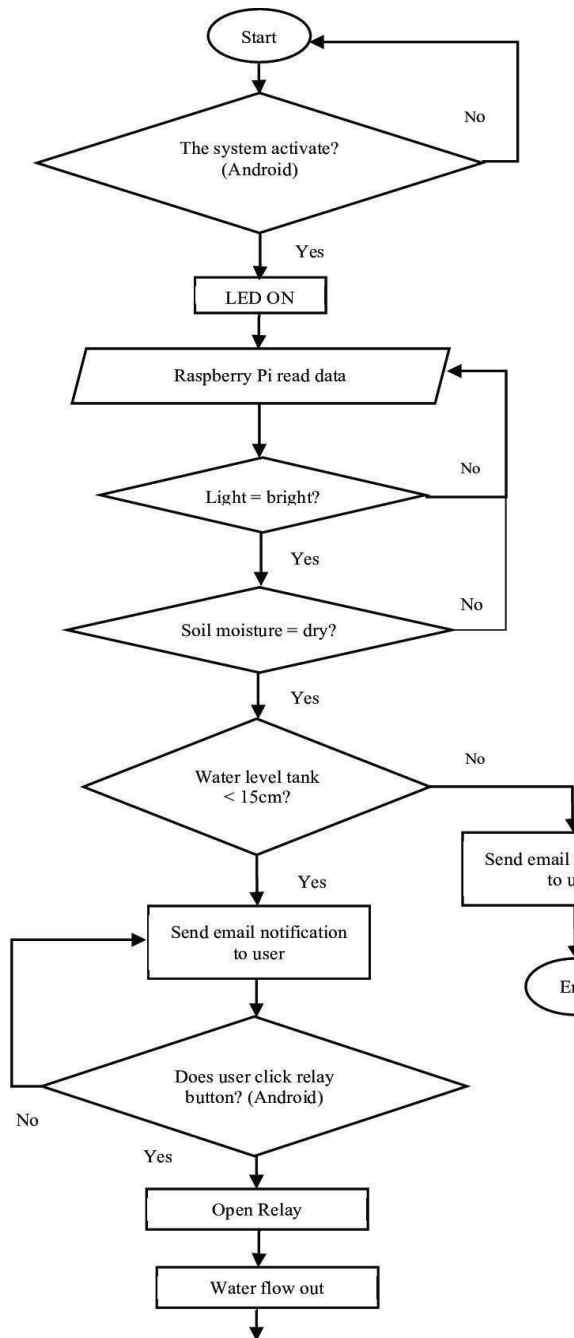


Fig: 1.6 MODEL ALGORITHM FLOW CHART

These commodities are a significant issue because of frequent price fluctuations in the Indonesian market. The success of horticulture cultivation is highly dependent on climate and environmental factors such as local microclimate, groundwater content, the temperature of the growth environment, humidity, and light intensity. Thus, it is essential to develop technologies that can solve these problems and ensure that horticulture in Indonesia becomes more productive both in quality and quantity. Previously, several studies have been presented in which they applied the IOT-based technique for improving farming. However, a study of IOT-based horticulture fits with Indonesia's condition. In the Existing System, people used to check and verify the moisture content in the fields manually.

This is a very difficult and risky process to check the condition at midnight. Even though the climate is good the humidity is unknown, so in the previous system, we have some disadvantages. Different sensors such as soil moisture and DHT11 are connected to the Arduino microcontroller's input pins within this device. The sensed sensor values are displayed in LCD. If the sensed value exceeds the threshold values set in the system, the relay circuit automatically switches the pump ON / OFF and it is connected to the driver circuit which helps to switch the voltage. By using this device, the farmer can at any time access the details of the field conditions. Many methodologies such as the Design of IoT-based Monitoring System for Intelligence Indoor MicroClimate Horticulture Farming in Indonesia, IOT-based Horticulture Monitoring System, Smart Agriculture, IOT based smart sensors agriculture, IOT Based Smart Agriculture.

Crops using it, Sensor based Automated Irrigation System, Design and Implementation of Automatic Plant Watering System has been proposed by many authors and the detailed explanation about these methods is as follows. Emil Robert Kaburuana (2019) proposed the micro- climate is very closely related to habitat and important for organisms on a micro-scale. Light intensity, soil moisture, soil temperature, air temperature, soil acidity, wind direction, and CO2 level are micro-climate factors that are very influential in aquaculture productivity. Monika Rabka, Dion Mariya nayagam, Dr Pancasila (2021) proposed that Remote monitoring and control of these farms is the obvious next step in trying to tackle the issues at hand. This is where the Internet of Things (IoT) comes into the fold. IoT is a network of Internet-connected devices that collect user-accessible data using sensors and processors and transfer it over wired or wireless networks. Controlled-Environment Agriculture will help make farmers' daily work more manageable by reducing the amount of time needed for physical monitoring.

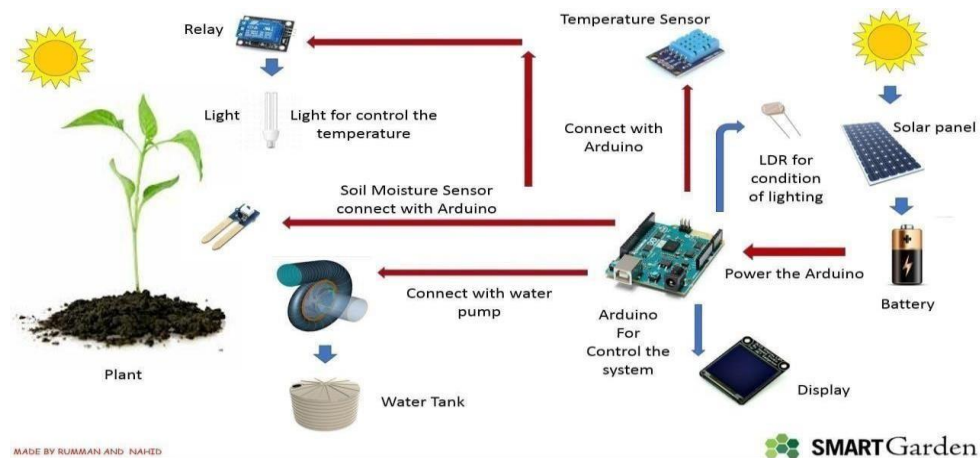


Fig: 1.7 IMAGINARY MODEL OF GARDEN MODELLING SYSTEM

The GSM and microcontroller are connected using MAX232. When moisture of the soil become low moisture sensor sense it and send signal to microcontroller, then the microcontroller gives the signal to mobile and it activate the buzzer. This buzzer indicates that valve needs to be opened by pressing the button in the called function signals are sent back to microcontroller. Microcontroller used can increase System Life and lower the power Consumption. There system is just limited to the automation of irrigation system and lacks in extra ordinary features[. By Observing above Methodologies there are some drawbacks such as while using Arduino it is expensive and it requires another microcontroller for WIFI purpose and memory purpose.

IoT (Internet of Things):

IoT as a term has evolved a long way as a result of the convergence of multiple technologies, machine learning, embedded systems, and commodity sensors. IoT is a system of interconnected devices assigned a UIDS, enabling data transfer and control of devices over a network. It reduced the necessity of actual interaction in order to control a device. IoT is an advanced automation and analytics system that exploits networking, sensing, big data, and artificial intelligence technology to deliver complete systems for a product or service. These systems allow greater transparency, control, and performance when applied to any industry or system.

Feature of IoT:

- A. Intelligence
- B. Connectivity
- C. Dynamic Nature
- D. Enormous Scale
- E. Sensing

F. Heterogeneity

G. Security

Intelligence:

IoT comes with the combination of algorithms and computation, software & hardware that makes it smart. Ambient intelligence in IoT enhances its capabilities which facilitate the things to respond in an intelligent way to a particular situation and supports them in carrying out specific tasks. In spite of all the popularity of smart technologies, intelligence in IoT is only concerned with a means of interaction between devices, while user and device interaction are achieved by standard input methods and graphical user interface

Connectivity:

Connectivity empowers the Internet of Things by bringing together everyday objects. The connectivity of these objects is pivotal because simple object-level interactions contribute to collective intelligence in the IoT network. It enables network accessibility and compatibility in the things. With this connectivity, new market opportunities for the Internet of things can be created by the networking of smart things and applications

Dynamic Nature:

The primary activity of the Internet of Things is to collect data from its environment, this is achieved with the dynamic changes that take place around the devices. The state of these devices changes dynamically, for example sleeping and waking up, connected and/or disconnected as well as the context of devices including temperature, location, and speed. In addition to the state of the device, the number of devices also changes dynamically with a person, place, and time

Enormous Scale:

The number of devices that need to be managed and that communicate with each other will be much larger than the devices connected to the current Internet. The management of data generated from these devices and their interpretation for application purposes becomes more critical. Gartner (2015) confirms the enormous scale of IoT in the estimated report where it stated that 5.5 million new things will get connected every day and 6.4 billion connected things will be in use worldwide in 2016, which is up by 30 percent from 2015. The report also forecasts that the number of connected devices will reach 20.8 billion by 2020

Sensing:

It wouldn't be possible without sensors that will detect or measure any changes in the environment to generate data that can report on their status or even interact with the environment. Sensing technologies provide the means to create capabilities that reflect a true awareness of the physical world and the people in it. The sensing information is simply the analog input from the physical world, but it can provide a rich understanding of our complex world

Heterogeneity:

Heterogeneity in the Internet of Things is one of the key characteristics. Devices in IoT are based on different hardware platforms and networks and can interact with other devices or service platforms through different networks. IoT architecture should support direct network connectivity between heterogeneous networks. The key design requirements for heterogeneous things and their environments in IoT are scalabilities, modularity, extensibility, and interoperability.

Security:

IoT devices are naturally vulnerable to security threats. As we gain efficiencies, novel experiences, and other benefits from the IoT, it would be a mistake to forget about the security concerns associated with it. There is a high level of transparency and privacy issues with IoT. It is important to secure the endpoints, the networks, and the data that is transferred across all over, it means creating a security paradigm.

Advantages of IoT

- A. Communication
- B. Automation and Control
- C. Information
- D. Monitor
- E. Time
- F. Money
- G. Automation of daily tasks leads to better monitoring of devices
- H. Efficient and saves time
- I. Saves money
- J. Better Quality of Life

Communication

IoT encourages communication between devices, also famously known as Machine-to-Machine (M2M) communication. Because of this, the physical devices are able to stay connected, and hence the total transparency is available with lesser inefficiencies and greater quality.

Information

It is obvious that having more information helps make better decisions. Whether it is mundane decisions such as needing to know what to buy at the grocery store or if your company has enough widgets and supplies, knowledge is power and more knowledge is better.

Monitor

The second most obvious advantage of IoT is monitoring. Knowing the exact quantity of supplies or the air quality in your home can further provide more information that could not have previously been collected easily. For instance, knowing that you are low on milk or printer ink could save you another trip to the store in the near future. Furthermore, monitoring the expiration of products can and will improve safety.

Time

As hinted in the previous examples, the amount of time saved because of IoT could be quite large and in today's modern life, we all could use more time.

Money

The biggest advantage of IoT is saving money. If the price of the tagging and monitoring equipments less than the amount of money saved, then the Internet of Things will be very widely adopted. IoT fundamentally proves to be very helpful to people in their daily routines by making the appliances communicate with each other in an effective manner thereby saving and conserving energy and cost. Allowing the data to be communicated and shared between devices and then translating it in our required way, makes our systems efficient.

Automation of daily tasks leads to better monitoring of devices

The IoT allows you to automate and control the tasks that are done on a daily basis, avoiding human intervention. Machine-to-machine

communication helps to maintain transparency in the processes. It also leads to uniformity in the tasks. It can also maintain the quality of service. We can also take necessary action in case of emergencies.

Efficient and saves time

The machine-to-machine interaction provides better efficiency, hence; accurate results can be obtained fast. This results in saving valuable time. Instead of repeating the same tasks every day, it enables people to do other creative jobs.

Saves Money

Optimum utilization of energy and resources can be achieved by adopting this technology and keeping the devices under surveillance. We can be alerted in case of possible bottlenecks, breakdowns, and damages to the system. Hence, we can save money by using this technology.

Better Quality of Life

All the applications of this technology culminate in increased comfort, convenience, and better management, thereby improving the quality of life.

Disadvantages of IoT:

- A. Compatibility
- B. Complexity
- C. Privacy / Security
- D. Safety
- E. Lesser Employment of Menial Staff
- F. Technology Takes Control of Life

Compatibility

Currently, there is no international standard of compatibility for the tagging and monitoring equipment. I believe this disadvantage is the easiest to overcome

Complexity

As with all complex systems, there are more opportunities for failure. With the Internet of Things, failures could skyrocket. For instance, let's say that both you and your spouse each get a message saying that your milk has expired, and both of you stop at a store on your way home, and you both purchase milk. As a result, you and your spouse have purchased twice the amount that you both need. Or maybe a bug in the software ends up automatically ordering a new ink cartridge for your printer each and every hour for a few days, or at least after each power failure when you only need a single replacement.

Privacy / Security

With all of this IoT data being transmitted, the risk of losing privacy increases. For instance, how well encrypted will the data be kept and transmitted? Do you want your neighbors or employers to know what medications you are taking or your financial situation?

Safety

Imagine if a notorious hacker changes your prescription. Or if a store automatically ships you an equivalent product that you are allergic to, a flavor that you do not like, or a product that is already expired. As a result, safety is ultimately in the hands of the consumer to verify any and all automation. As all the household appliances, industrial machinery, public sector services like water supply and transport, and many other devices are connected to the Internet, a lot of information is available on it. This information is prone to attack by hackers. It would be very disastrous if private and confidential information is accessed by unauthorized intruders.

Lesser Employment of Menial Staff

The unskilled workers and helpers may end up losing their jobs in

the effect of automation of daily activities. This can lead to unemployment issues in society. This is a problem with the advent of any technology and can be overcome with education. With daily activities getting automated, naturally, there will be fewer requirements for human resources, primarily, workers and less educated staff. This may create an Unemployment issue in society.

Technology Takes Control of Life

Our lives will be increasingly controlled by technology and will be dependent on it. The younger generation is already addicted to technology for every little thing. We have to decide how much of our daily lives are we willing to mechanize and be controlled by technology.

Application Grounds of IoT:

- A. Wearables
- B. Smart Homes
- C. Health Care
- D. Agriculture
- E. Industrial Automation
- F. Government and Safety

Wearables

Wearable technologies are a hallmark of IoT applications and are one of the earliest industries to have deployed IoT at its services. Fit Bits, heart rate monitors, smartwatches, and glucose monitoring devices reflect the successful applications of IoT.

Smart homes

This area of application is concerned to this particular project, so a detailed application is discussed further. *Jarvis*, an AI home automation employed by Mark Zuckerberg.

Health Care

IoT applications have turned the reactive medical-based system into the proactive wellness-based system. IoT focuses on creating systems rather than equipment. IoT creates a future of medicine and healthcare which exploits a highly integrated network of sophisticated medical devices. The integration of all elements provides more accuracy, more attention to detail, faster reactions to events, and constant improvement while reducing the typical overhead of medical research and organization.

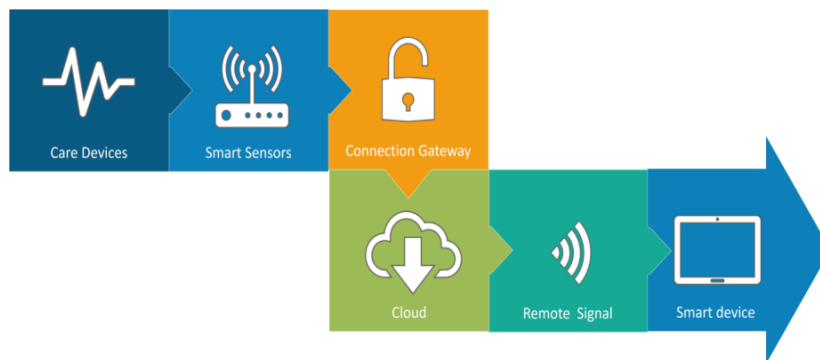


Figure 1.8 Working of IoT enables care devices

Agriculture

A greenhouse farming technique enhances the yield of crops by controlling environmental parameters. However, manual handling results in production loss, energy loss, and labor cost, making the process less effective. A greenhouse with embedded devices not only makes it easier to be monitored but also, enables us to control the climate inside it. Sensors measure different parameters according to the plant requirement and send them to the cloud. It, then, processes the data and applies a control action.

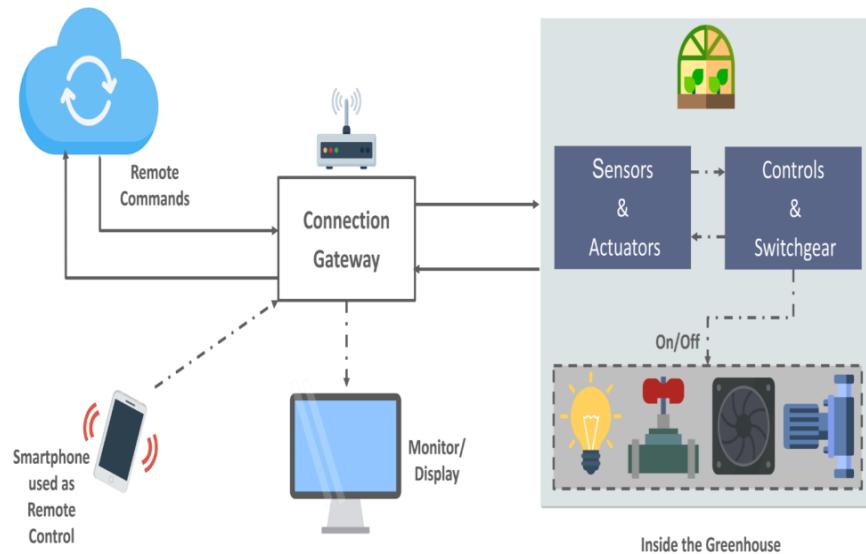


Figure 1.9 IoT Controlled Greenhouse Environment

BENEFITS OF HORTICULTURE

Depending on the goal of IoT implementation and technology used, you can expect various benefits for your company. Let's take a look at how applications of IoT in agriculture can help increase the efficiency and profitability of farming:

1. Reductions in depression
2. Less anxiety
3. Increased life satisfaction
4. Better quality of life
5. Enhanced sense of community.

SCOPE OF HORTICULTURE

The output of food grains has witnessed a record surge, as for 2020- 21, total Food grain Production in the country is estimated at record 303.34 million tons which is higher by 5.84 million tons than the production of food grain of 297.50 million tons achieved during 2019-20 (as per Ministry of Agriculture & Farmers Welfare). One can easily say that India is self-sufficient in food grain production. Right now, there is a demand for advancements in which our country has huge potential. There are so many concepts that are being covered under the name of Horticulture namely — monoculture, the concept of Permaculture to name a few. Apart from degree programs, there are a lot of groups wherein students from all walks of life are actively participating to spread awareness about the field.

HORTICULTURE JOBS AND CAREER

Horticulture is an extremely diversified field with limitless career opportunities in a variety of job settings. The level of training for the jobs may differ; it could range from a vocational to a proper college degree or KVK (*Krishi Vigyan Kendra created by Indian Council for Agricultural Research, abbreviated as ICAR*). Ideally, to grab a good job position in Horticulture, one must have a certified degree in this discipline. Having a proper degree acts as a bonus, as the person will have an in-depth knowledge of the field and will get offers at supervisory or managerial levels, while post-graduation and doctorate level degree will provide jobs in research or teaching.

Let us talk about job opportunities as per the branches:

1. **Floriculturists** are specialized in planning and design of exterior/interior landscapes for parks, recreational areas, campuses, industrial sites, institutional grounds, shopping malls, and other large projects.
2. **Olericulturists** can kick-start their career in almost every industry, research institutes, universities and other organizations at different levels. These personnel have more demand in the private sector as the vegetable growers have a good future, especially in the seed industry.
3. **Pomologists** are well acquainted with breeding technology, tissue culture techniques, integrated nutrient management (INM), integrated pest management technique (IPM) and protected cultivation techniques of fruits. They hold a bright future in the ICAR, State Agricultural Universities and in other organizations.

SECTOR-WISE HORTICULTURE JOBS IN INDIA

There is Sample scope for people wanting to be full-time/part-time horticulturist, whether one has their own piece of land or not, this line is open to all. If one needs to know sector-wise jobs available in India, read on to check the same - **In Government and Public Sector:**

1. **Civil Servants (IAS/IFS)** - For this, candidates have to appear for competitive exams conducted by Union Public Service Commission (UPSC)
2. **Scientists** -, For this one has to take examinations organized by the Agriculture Scientist Recruitment Board, ICAR, New Delhi
3. **Lecturers, Assistant Professors or Training Associates** in Agricultural Universities and Colleges
4. **Horticulture/Agriculture Officers or Assistant Agriculture Officers** - For this, candidates need to appear for competitive exams conducted by State Public Service Commissions
5. **Technical/ Training Assistant** in SAU, ICAR, DRDO, IARI and CSIR
6. **Horticulture/Food/ Marketing Inspector/Agriculture Development Officer** in DSSSB/HPS

IN THE PRIVATE SECTOR

One can be a Horticulturist or Supervisor (Landscape) in Industries, Hotels, Golf Courses and Construction Companies to name a few. For people with sufficient experience, marketing jobs are also offered by various pesticide and insecticide companies.

SELF EMPLOYEMENT IN HORTICULTURE

With a graduation degree in Horticulture/Agriculture, it is quite easy to start an Agriculture clinic. One can also start their own Nursery and grow their fruit plants and ornamental plants by the plant material using various techniques like grafting, budding, tissue culture, layering and vegetative propagation.

FELLOWSHIP IN HORTICULTURE SECTOR BY UGC:

The Rajiv Gandhi National Fellowship (RGNF) Scheme is open to SC/ST candidates, wishing to pursue higher studies as regular and full-time PhD scholars in the discipline of Horticulture Science.

FELLOWSHIP IN HORTICULTURE SECTOR BY ICAR:

Indian Council of Agriculture Research (ICAR), New Delhi offers JRF (Junior Research Fellowship) and SRF (Senior Research Fellowship) to those who qualify the respective examinations conducted by ICAR from time to time.

CHAPTER 2

LITERATURE REVIEW

The following shows a survey done for dual home automation for with and without internet on Realtime which includes an instant feedback mechanism that drives the appliances. This system is reliable to integrate on multiple platforms with the help of ESP32 master which serves as standard firm ware. Further, the study was extended to multiple operation platforms like Linux, Windows, and IOS are discussed as follows. In this detailed survey, we have learned a lot in stabilizing our concepts from the existing feedback mechanisms that were designed in the previous study **Satyendra K. Vishwakarma, Prashant Upadhyaya, Babita Kumari, and Arun Kumar**

Mishra, IJSR “Smart Energy Efficient Home Automation System Using IoT” IJSR Transaction on Computer Science Engineering 2021.

This paper presents a step-by-step procedure of a smart home automation controller. It uses IoT to convert home appliances to smart and intelligent devices, with the help of design control. An energy-efficient system is designed that accesses the smart home remotely using IoT connectivity. The proposed system mainly requires, Node MCU as the microcontroller unit, IFTTT to interpret voice commands, Adafruit a library that supports MQTT acts as an MQTT broker, and Arduino IDE to code the microcontroller. The smart home is implemented with the main control unit that is connected to the 24- hour available Wi-Fi network. To ensure, that the Wi-Fi connection does not turn off, the main controller is programmed to establish an automatic connection with the available network and connected to the auto power backup.

Pros: The target scaling factor is efficient throughout the multiple platforms switching

Cons: Slower transit cycles when compared to CoAP, low scalability, and lack of security encryption

**Shardha Somani, Parikshit Solunke, Shaunak Oke, Parth Medhi.
Prof. P. P. Laturkar, IEEE
IoT Based Smart Security and Home Automation”, IEEE
Transactions on Augmented Reality, 2021**

This paper focuses on a system that provides features of Home Automation relying on IoT to operate easily, in addition to that it includes a camera module and provides home security. The android application basically converts smartphones into a remote for all home appliances. Security is achieved with motion sensors if movement is sensed at the entrance of the house; a notification is sent that contains a photo of the house entrance in real-time. This notification will be received by the owner of the house via the internet such that the app can trigger a notification. So, the owner can raise an alarm in case of any intrusion or he/she can toggle the appliances like opening the door if the person is a guest. The system uses Raspberry Pi, a small-sized computer that acts as a server for the system. The smart home consists of two modules. Home automation consists; of a fanlight and door controller, and a security module that consists; of a smoke sensor motion sensor, and camera module.

Pros: Implementation of IR Interface was an excellent Idea for creating universal remote

Cons: The system Uses Infrared Radiation for data transfer which is much faster than CoAP but could be easily mapped with 38 kHz of regular frequency

**Tui-Yi Yang, Chu-Sing Yang, IJEEE “A Dynamic Distributed
Energy Management Algorithm of Home Sensor Network**

ELECTRICAL AND ELECTRONICS ENGINEERS,2017

This paper proposes an optimization of home power consumption based on PLC (Power Line Communication) for an easy-to-access home energy consumption. This also proposes a Zigbee and PLC-based renewable energy gateway to monitor the energy generation of renewable energies. ACS and DDEM algorithms are proposed for the design of intelligent distribution of power management systems to make sure ongoing power supply of home networks. To provide efficient power management the power supply models of home sensor networks are classified into groups viz. main supply only, main supply and backup battery, rechargeable battery power, and non-rechargeable battery power. Devices with particular features are assigned to these groups. It targets establishing a real-time processing scheme to address variable sensor network topologies.

Pros: Fast and secured since the data encryption is 64bit ratio and it follows MQTT protocol

Cons: Does not support large database size, and it has no support for ROLE, COMMIT and Stored Procedures

Tushar Chaurasia, and Prashant Kumar Jain “Enhance Smart Home Automation System based on Internet of Things”, Transactions on Artificial Neural Networks, 2019

This paper proposes a system that develops a model to reduce the computation overhead in existing smart home solutions that use various encryption technologies like AES, ECHD, hybrid, etc. these solutions use an intermediate gateway for connecting various sensor devices. The proposed model provides a method for automation with sensor- based learning. These smart home devices with sensors can configure themselves autonomously and can operate without human intervention. This work minimizes encryption decryption and focuses on authentication and automation of smart home devices with learning. The system bypasses the local gateway mentioned in the existing system to provide better security for smart home devices and sensor data and save computation overhead. The real-time broker cloud is directly connected with the smart home and manages all incoming and outgoing requests between users and devices.

Pros: Bringing AR with Deep Neural schema is an Excellency and this system can be integrated with the 7 senses of the future world.

Cons: It has a range of support between 3.5Hz to 75Hz which in turn directly matches the neural frequency that potentially messes up sensory organs.

Suraj, Ish Kool, Dharmendra Kumar, Shovan Barman “Visual Machine Intelligence for Home Automation”, MDPI Transactions on Applied Science, 2020.

The paper presents a vision-based machine intelligence system to sense the on/off state of common home appliances. The proposed method of sensing the state of appliances results in a novel home

automation system. The accessibility of the suite of devices in the home over a remote network is facilitated by the IP Addressing methods in the IoT. This project uses two boards viz. Raspberry Pi and Intel Galileo Gen 2. The communication between the User devices, Raspberry Pi, and the Intel Galileo boards happens over a wireless network. The UDP protocol is deployed to facilitate the wireless communication of the nodes present in the home automation network. A Pi Cam and a USB Logitech camera are attached to the rotating shaft of two different servo motor capture snapshots

Modality to automate the appliances, as privacy concerns may emerge while using the images from some specific places, as a counter to this issue, an SPDT switch is added to the Raspberry Pi which when turned off ensures that even if the images are taken from the webcams, they are just passed as inputs to the machine learning models and are not displayed on the website when the users access the website on the server address obtained from Raspberry Pi.

Pros: High Visual and Artificial Database was integrated which can be a link between and virtual and physical world. A creative contextual database has created a huge responsive factor

Cons: Superimposing virtual environmental capacity has no range of lower frequency AR camera support

Vikram N, Harish KS, Nihaal M S, Raksha Umesh, and, Shetty Asshik Ashok Kumar,

“A Low-Cost Home Automation System using Wi-Fi-based Wireless sensor Network incorporating Internet of things”, Procedia Computer Science Transactions on Mobile Device, 2015

This paper illustrates a methodology to provide a low-cost Home Automation System (HAS) using Wireless Fidelity (Wi-Fi). This crystallizes the concept of internetworking of smart devices. A Wi-Fi-based Wireless Sensor Network (WSN) is designed for the purpose of monitoring and controlling the environmental, safety, and electrical parameters of a smart interconnected home. The different sections of the HAS are; the temperature and humidity sensor, gas leakage warning system, fire alarm system, burglar alarm system, rain-sensing, switching and regulation of load & voltage, and current sensing. The primary requirement of HAS to monitor and control devices is accomplished using a Smartphone application. The application is developed using Android Studio based on the JAVA platform and the User Interface is exemplified. The primary focus of the paper is to develop a solution cost-effective and flexible in the control of devices and implements a wide range of sensors to capture various parameters.

Pros: Implementing a local server reduces cognitive allocation in the server

Cons: Error Factors are high since it is purely based on local server data. Mrs. Paul Jasmin Rani, Jason Baktha kumar, Praveen Kumar B, Praveen Kumar U.

Santhosh Kumar. “Voice Controlled Home Automation System using Natural Language Processing and Internet of Things”, INCC Transactions on National Security Science and Computation, 2018

The paper focuses on the construction of a fully functional voice-based home automation system that uses the Internet of Things, Artificial Intelligence, and Natural Language Processing (NLP) to provide a cost-effective, efficient way to work together with home appliances using various technologies such as GSM, NFC, etc. it implements a seamless integration of all the appliances to a central console, i.e., the mobile device. The prototype uses Arduino MK1000, known as Genuine MK1000. The NLP in this project gives the user the freedom to interact with the home appliances with his/her own voice and normal language rather than complicated computer commands. The appliances are connected to the mobile device through an Arduino Board that establishes the concept of the Internet of Things. The Arduino Boards are interfaced with the appliances and programmed in such a way that they respond to mobile inputs. **Pros:** Only a few notable parameters throughout the project

Cons: The rate of prediction is proportionally less when compared to real-world predictions

Jonathan J. Hull, Berna Erol, Jamey Graham, Qifa Ke, Hidenobu Kishi, Jorge Moraleda, Daniel G. Van Olst, Research Gate “Paper-Based Augmented Reality”, ResearchGate Transaction on Camera and Paper documentation, 2007

A new method for augmenting paper documents with electronic information is described that does not modify the format of the paper document in any way. Applicable to both commercially printed documents as well as documents that are output from PCs,

Pros: Augmented reality with virtual automation was brought to the physical world with the paper content

Cons: Linking patches of text will increase a lot of security reasons

Mikko Kytö^{1,2}, Barrett Ens², Thammathip Piumsomboon², Gun A. Lee², and Mark Billingham², Research Gate “Pinpointing: Precise Head- and Eye-Based Target Selection for Augmented Reality”, Research Gate Transactions on Augmented Reality in Computer Science Engineering, 2018

Head and eye movement can be leveraged to improve the user's interaction repertoire for wearable displays. Head movements are deliberate and accurate and provide the current state-of-the-art pointing technique. Eye gaze can potentially be faster and more ergonomic but suffers from low accuracy due to calibration errors and the drift of wearable eye-tracking sensors. This work investigates precise, multimodal selection techniques using head motion and eye gaze. A comparison of speed and pointing accuracy reveals the relative merits of each method, including the achievable target size for robust selection. We demonstrate and discuss example applications for augmented reality, including compact menus with deep structure, and a proof-of-concept method for online correction of calibration drift.

Pros: Accuracy has reached 97% with a simple algorithm

Cons: 97% precise and accurate but depends purely on real-time saturation and hue point of large images

Subramani Roy Choudri, A. Divija, G. V V N Vijayalakshmi, P. Vamsi, JARTMS “TOUCHLESS HOME AUTOMATION USING AUGMENTED REALITY”, JARTMS

Transactions on Augmented Reality and Web Interface, 2021

As human life is heading towards a busy schedule it becomes necessary to automate our home appliances. Human error is something that cannot be completely erased. With the busy schedule in hand, there is defiantly a possibility of missing something that may be trivial to us but can result in a catastrophe. For these reasons, Our Project home automation can increase efficiency, security and reliability. AR has recently evolved for the automation of various electrical appliances by popping virtual objects into the real world.

Pros: Target Image can be linked to the Virtual world

Cons: Target Image can be linked-to automation with an augmented environment but in the case of wet hands, this linking process will not produce tokens to respective servers

2.1 LITERATURE SUMMARY

The system has the capacity to adapt based on the user input which the farmer can input through the smart horticulture application. The farmer can select a profile based on the season and the crop for irrigation and schedule and plan the water resource utilization sensibly. The volumetric water content in the soil is a primary factor which gives a suggestion that water is required for the crops. In the absence of this system the farmer has to manually inspect all the crops by inspecting the soil in the fields which is tedious, time-consuming, and straining. This can be taken care of by the intelligent system which informs the user whenever the water content goes below the threshold set by the farmer himself. Intrusion of animals especially cows, monkeys, dogs to the fields is a very common issue and one of the factors for disruption or disturbance to the yield.

2.2 PROBLEM STATEMENT

In addition to managing scarcity and conflict between water users, the available fresh water is further contaminated by the human and animal population and the pollution levels have increased at an alarming rate. This if continues, will be leading to the limitation of food production which in turn will affect human productivity, and thus the entire ecosystem will be affected in the years to come. The primary

and the most important reason for this problem is the tremendous increase population which has increased at a rate that is faster than food production rate.

2.3 OBJECTIVE

1. To develop a clean and hygienic environment with a proper dust disposal system
2. To process the aquatic waste into profit for public use
3. To create an awareness and proper disposal system for upcoming generations
4. To make the customer aware of accountability behind the job such as the system for solid waste inspection and management
5. Design of an Independent Smart Agricultural Management System(SAMS)
6. Wireless Control of Home appliances (Switch, Cloud, and, Bluetooth)
7. Monitoring status of appliances
8. Secure connection channels between application and ESP32 Master
9. Controlled by any device capable of Wi-Fi (Android, iOS, PC)
10. An extensible platform for future enhancement

CHAPTER 3

PROPOSED METHODOLOGY

3.1 ESP32 MASTER:

NodeMCU ESP32 (Node Microcontroller Unit) is a low-cost open-source IoT platform. It initially included firmware that runs on the ESP8266 Wi-Fi SoC from Express if Systems and hardware that was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added. NodeMCU-based ESP32 is an open-source firmware for which open-source prototyping board designs are available. The name “NodeMCU” combines “node” and “MCU” (micro-controller unit). The term “NodeMCU” strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language. The firmware is based on the project and built on the Express if Non-OS SDK for ESP8266. It uses many projects, such as a- JSON and SPIFFS. Due to resource constraints, users need to select the modules relevant to their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented. The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications.



Figure 3.1 ESP32 Master Development Board

Pin Configuration of ESP32 Development Board

This module provides an access to the GPIO subsystem. All the access is based on the I/O index number of Node MCU kits, not the internal GPIO pins. For example, the D0 pin on the development kit is mapped to GPIO pin 16. Node MCU provides access to the GPIO pins and the following pin mapping table is a part of the API Documentation.

Working Temperature	- 40°C ~ 125°C	- 40°C ~ 125°C
Specifications	ESP8266	ESP32
MCU	Xtensa® Single-Core 32-bit L106	Xtensa® Dual-Core 32-bit LX6 600 DMIPS
802.11 b/g/n Wi-Fi	Yes, HT20	Yes, HT40
Bluetooth	None	Bluetooth 4.2 and below
Typical Frequency	80 MHz	160 MHz
SRAM	160 kBytes	512 kBytes
Flash	SPI Flash , up to 16 MBytes	SPI Flash , up to 16 MBytes
GPIO	17	36
Hardware / Software PWM	None / 8 Channels	1 / 16 Channels
SPI / I2C / I2S / UART	2/1/2/2	4/2/2/2
ADC	10-bit	12-bit
CAN	None	1
Ethernet MAC Interface	None	1
Touch Sensor	None	Yes
Temperature Sensor	None	Yes
Working Temperature	- 40°C ~ 125°C	- 40°C ~ 125°C

Fig:3.2 ESP8266 (vs) ESP32 Master

Development Board Chart

D0 (GPIO16) can only be used for GPIO read/write. It does not support open-drain/interrupt/PWM/I²C or 1-Wire. The ESP32 Node MCU has a total of 30 pins that interface it to the outside world. The pins are grouped by their functionality as:

1. Power pins:

There are four power pins viz. one VIN pin & three 3.3V pins. The VIN pin can be used to directly supply the ESP8266 and its peripherals if you have a regulated 5V voltage source. The 3.3V pins are the output of an onboard voltage regulator. These pins can be used to supply power to external components.

2. GND:

Is it a ground pin of the ESP8266 Node MCU development board?

3. I²C Pins:

Are used to hook up all sorts of I²C IC sensors and peripherals in your project. Both I²C Master and I²C Slave are supported. I²C interface functionality can be realized programmatically, and the clock frequency is 100 kHz at a maximum. It should be noted that the I²C clock frequency should be higher than the slowest clock frequency of the slave device.

4. GPIO Pins:

ESP8266 Node MCU has 17 GPIO pins that can be assigned to various functions such as I2C, I2S, UART, PWM, IR Remote Control, LED Light, and Button programmatically. Each digital-enabled GPIO can be configured to internal pull-up or pull-down, or set to high impedance. When configured as an input, it can also be set to edge-trigger or level-trigger to generate CPU interrupts.

5. ADC Channel:

The Node MCU is embedded with a 10-bit precision SAR ADC. The two functions can be implemented using ADC viz. Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. However, they cannot be implemented at the same time.

6. UART Pins:

ESP8266 Node MCU has 2 UART interfaces, i.e., UART0 and UART1, which provide asynchronous communication (RS232 and RS485) and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 & CTS0 pins) can be used for communication. It supports flow control. However, UART1 (TXD1 pin) features only data transmit signal so, it is usually used for printing logs.

7. SPI Pins:

ESP8266 features two SPIs (SPI and HSPI) in slave and master modes. These SPIs also support the following general-purpose SPI features:

- 1) 4 timing modes of the SPI format transfer
- 2) Up to 80 MHz and the divided clocks of 80 MHz
- 3) Up to 64-Byte FIFO

8. SDIO Pins:

ESP8266 features a Secure Digital Input/Output Interface (SDIO) which is used to directly interface SD cards. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

9. PWM Pins:

The board has 4 channels of Pulse Width Modulation (PWM). The PWM output can be implemented programmatically and used for driving digital motors and LEDs. PWM frequency range is adjustable from 1000 μ s to 10000 μ s, i.e., between 100 Hz and 1 kHz.

10. Control Pins:

Are used to control ESP8266. These pins include the Chip Enable pin (EN), Reset pin (RST) and WAKE pin.

- 1) EN pin - The ESP8266 chip is enabled when the EN pin is pulled HIGH. When pulled LOW the chip works at minimum power.
- 2) RST pin - RST pin is used to reset the ESP8266 chip.
- 3) WAKE pin - A wake pin is used to wake the chip from a deep sleep.

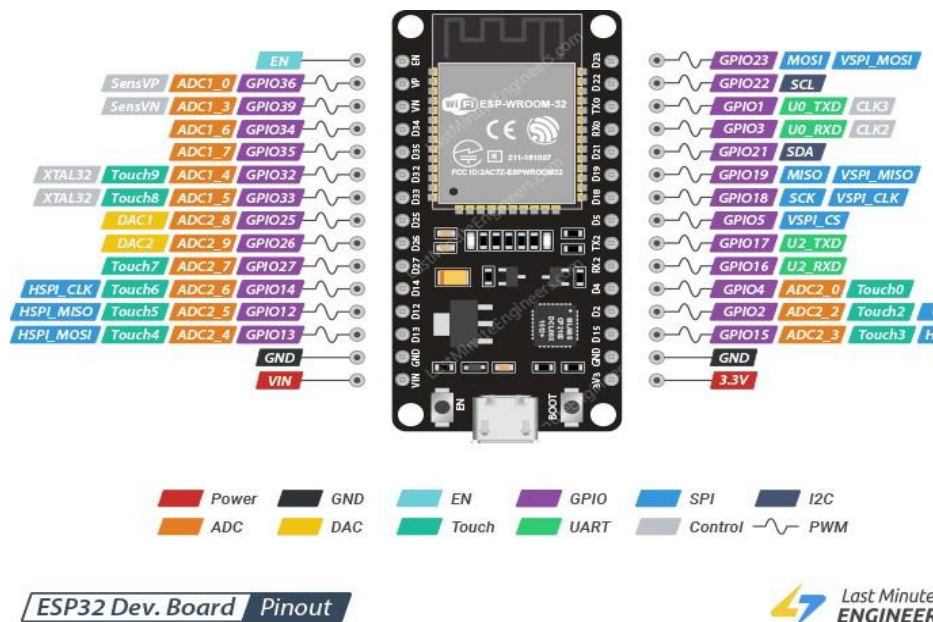


Figure:3.3 ESP32 Dev. Board Master Pinout

ESP 32-E Module

The development board equips the ESP-12E module containing an ESP8266 chip having Tensilica Xtensa® 32-bit LX106 RISC microprocessor which operates at 80 to 160 MHz adjustable clock frequency and supports RTOS. There's also 128 KB RAM and 4MB of Flash memory (for program and data storage) just enough to cope with the large strings that make up web pages, JSON/XML data, and everything we throw at IoT devices nowadays.

The ESP8266 Integrates an 802.11b/g/n HT40 Wi-Fi transceiver, so it can not only connect to a Wi-Fi network and interact with the Internet, but it can also set up a network of its own, allowing other devices to connect directly to it. This makes the ESP8266 Node MCU even more versatile.

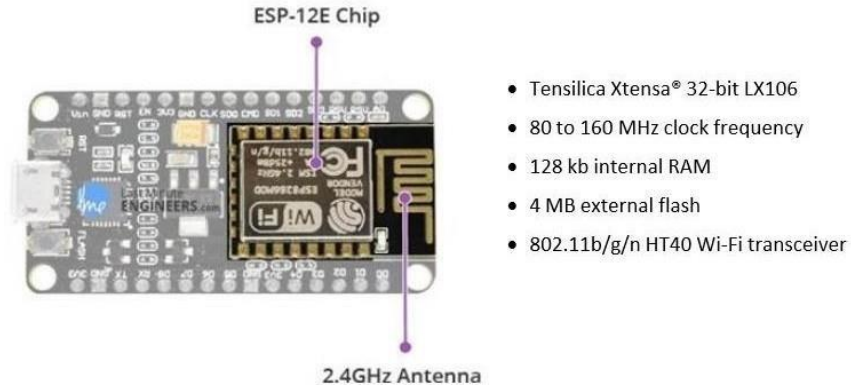


Figure: 3.4 ESP 32E Module in ESP32 Master Development Board

Power Requirements:

As the operating voltage range of ESP8266 is 3V to 3.6V, the board comes with a LDO voltage regulator to keep the voltage steady at 3.3V. It can reliably supply up to 600mA, which should be more than enough when ESP8266 pulls as much as 80mA during RF transmissions. The output of the regulator is also broken out to one of the sides of the board and labeled as 3V3. This pin can be used to supply power to external components. Power to the ESP8266 Node MCU is supplied via the onboard Micro B USB connector. Alternatively, if you have a regulated 5V voltage source, the VIN pin can be used to directly supply the ESP8266 and its peripherals.

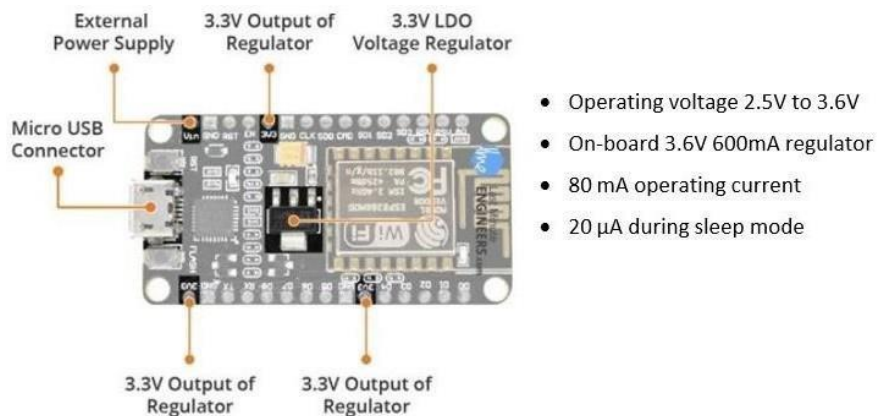


Fig: 3.5 Power Module on an ESP32 Master Development Board

Peripheral I/O:

The ESP8266 Node MCU has total 17 GPIO pins broken out to the pin headers on both sides of the development board. These pins can be assigned to all sorts of peripheral duties, including:

- 1) ADC channel - A 10-bit ADC channel.
- 2) UART interface - UART interface is used to load code serially.
- 3) PWM outputs - PWM pins for dimming LEDs or controlling motors.
- 4) SPI, I2C & I2S interface - SPI and I2C interface to hook up all sorts of sensors and peripherals.
- 5) I2S interface - I2S interface if you want to add sound to your project.

As a result of the pin multiplexing feature (Multiple peripherals multiplexed on a single GPIO pin), a single GPIO pin can act as

On-Board Switches and LED Indicators:

The ESP8266 Node MCU features two buttons. One marked as RST located on the top left corner is the Reset button, used of course to reset the ESP8266 chip. The other FLASH button on the bottom left corner is the download button used while upgrading firmware. The board also has a LED indicator that is user programmable and is connected to the D0 pin of the board.

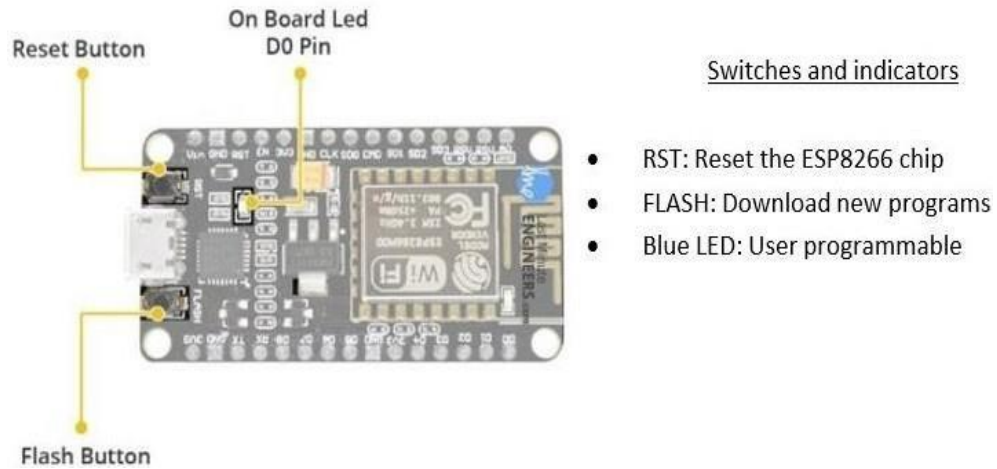


Fig: 3.6 On-Board Switches and LED Indicators

The board includes a CP2102 USB-to-UART Bridge Controller from Silicon Labs, which converts USB signal to serial and allows your computer to program and communicate with the ESP8266 chip.

Mostly these days devices download and install drivers on their own, automatically. Windows don't know how to talk to the USB driver on the Node MCU so it can't figure out that the board is a Node MCU and proceed normally. Node MCU And it is an ESP8266 Wi-Fi module-based development board. It has got a Micro USB slot that can directly be connected to the computer or other USB host devices. It has got 15X2 header pins and a Micro USB slot, the headers can be mounted on a breadboard and the Micro USB slot is to establish a connection to the USB host device. It has CP2120 USB to serial converter. In order to install CP2120 (USB to serial converter), the user is needed to download the driver for the same. Once a user downloads drivers as per its respective operating system, the system establishes a connection to Node MCU. The user needs to note down the COM port allotted to the newly connected USB device (Node MCU) from the device manager of the system. This com port number will be required while using Node MCU Amica. As the CP2120 driver is been installed, the Node MCU can be programmed using Arduino IDE software by coding in embedded C. this requires ESP8266 board installation in Arduino IDE from the board manager and assigning communication port.

The development of a smart horticulture system using sensors, a microcontroller within an IoT system is presented. The aim of the implementation is to demonstrate the smart and intelligent capabilities of the microcontroller to allow the decisions to be taken on watering the plants based on the continuous monitoring of the environmental conditions in the field. The system is as shown in Fig. 1. It also aims at a predefined irrigation schedule as per the farmer's convenience, uploaded into the application developed for the same. The implementation is a photovoltaic-powered automated irrigation system that consists of a distributed wireless network of soil moisture and temperature sensors deployed in plant root zones. These sensors continuously monitor the parameters and send them to the Arduino board for further processing which acts as an IoT gateway. This gateway has been given wireless capability by installing a WiFi module that will be updating the data to the cloud.

3.2 ADVANTAGES OF PROPOSED METHODOLOGY

The system has the capacity to adapt based on the user input which the farmer can input through the smart horticulture application. The farmer can select a profile based on the season and the crop for irrigation and schedule and plan the water resource utilization sensibly. The volumetric water content in the soil is a primary factor which gives a suggestion that water is required for the crops. In the absence of this system, the farmer has to manually inspect all the crops by inspecting the soil in the fields which is tedious, time-consuming, and straining.

This can be taken care of by the intelligent system which informs the user whenever the water content goes below the threshold set by the farmer himself. The intrusion of animals especially cows,

monkeys, dogs, etc into the fields is a very common issue and one of the factors for disruption or disturbance to the yield. The solar power bank used for system testing contains a 26800mAh battery. By calculating the current consumption, we estimate that the power bank can support the client for up to 4 days continuously.

The Firebase JSON nodes as recorded during the greenhouse client test. The current date and time are accessed using the Network Time Protocol (NTP) and stored in variables that are then used as part of the data path for the JSON object. This allows the creation of separate nodes for each day and better organization of stored data. Simple MATLAB code was used for RGB to gray conversion and thresholding of the photo. The ThingSpeak channel with all the sensor data visualized on graphs along with the unprocessed and processed photos of the plant being monitored in the greenhouse.

PRINCIPLE AND OPERATION:

Node MCU is an open-source IoT platform. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware that is based on the ESP-12 module. The term “Node MCU” by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the project and built on the Espressif Non-OS SDK for ESP8266. It uses many open-source projects, such as JSON, and SPIFFS.

Advantages of ESP32:

1. Low cost, the Node MCU is less costly compared to any other IoT-based device.
2. Node MCU has Arduino Like hardware I/O. It is becoming very popular these days that Arduino IDE has extended its software to work in the field of ESP 8266 Field module version.
3. Node MCU has an easily configurable network API.
4. Integrated support for the Wi-Fi network: ESP 8266 is incorporated in Node MCU, which is an easily accessible Wi-Fi module.
5. Reduced size of the board.
6. Low power consumption.

Disadvantages of ESP32:

- 1) The operation of the circuit depends on the working internet connection. If the working internet connection is not available then.
- 2) Node MCU also depends on the free server provided by the thirdparty, if the free server is not working then it will not run.
- 3) Node MCU has fewer resources for official documentation
- 4) Need to learn a new language and IDE
- 5) Reduced pinout
- 6) Scarce documentation

BLYNK APPLICATION:

The Blynk application was designed for the primary purpose of the Internet of Things. **Blynk** is a platform with IOS and Android apps to control Arduino, Raspberry Pi, and the likes over the Internet. It's a digital dashboard where a graphic interface for a proto type can be built by simply dragging and dropping widgets. It can control hardware remotely, it can display sensor data, can store and visualize data, and possesses a lot more functionality. There are three major components in the platform:

- **Blynk Application:** allows to you create amazing interfaces for your projects using various widgets we provide.
- **Blynk Server:** responsible for all the communications between the smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. It is a open-source, could easily handle thousands of devices, and can even be launched on a Raspberry Pi.
- **Blynk Libraries:** for all the popular hardware platforms - enable communication with the server and process all the incoming and outgoing commands.

Every time a radio button is accessed in the Blynk application the message travels to the Blynk Cloud, where it finds the specific hardware by the unique generated authentication token. It works in the same way in the opposite direction.

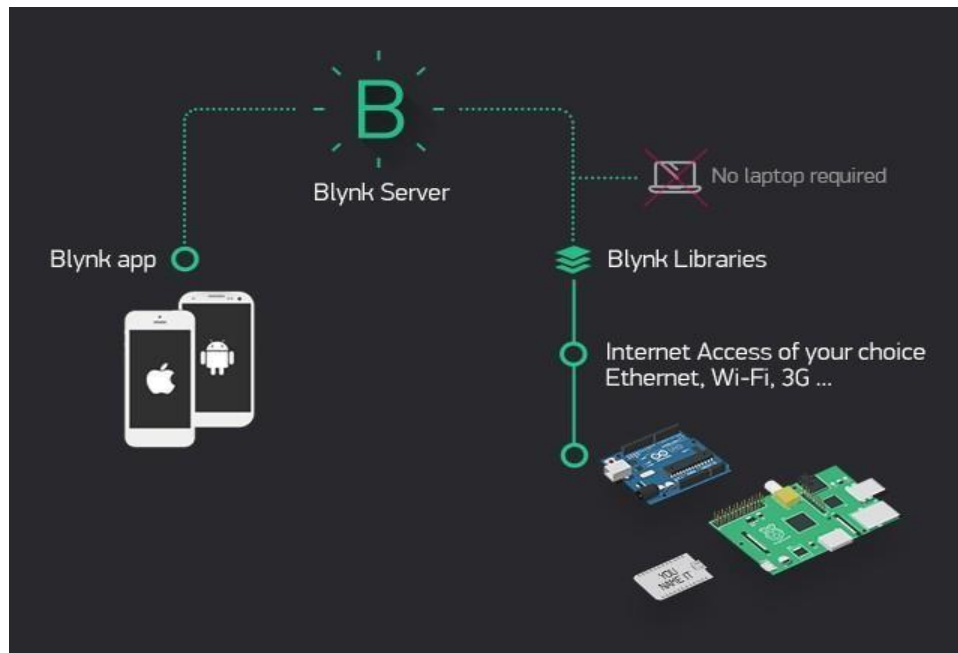


Fig 3.7 Working Principle of Blynk application

WIRELESS COMMUNICATION NETWORK:

The prototype aims to wireless control over home appliances with the technology of IoT. As discussed earlier, IoT supports various wireless communication protocols, like Bluetooth, Z-Wave, Zigbee, etc. this prototype uses Wi-Fi as a wireless communication network to establish remote access over home appliances. This is because Wi-Fi has its own advantages over other wireless communication protocols.

Advantages of Wi-Fi over other wireless technologies like Bluetooth and ZigBee

1. Bluetooth is generally used for point-to-point networks and Bluetooth operates at a much slower rate of around 720 Kbps which is very small for video transfer or moving a large amount of data like the image captured from a camera, whereas the bandwidth of Wi-Fi can be up to 150Mbps and very ideal for video transmission.
2. Wi-Fi is a very much more secure means of communication than Bluetooth.

3. Wi-Fi connection to send video, audio, and telemetry operation, while accepting remote control commands from an operator who can be located virtually anywhere in the world.

4. Robots are already being eyed for obvious tasks like conducting search-and-rescue missions during emergencies or hauling gear for soldiers in the jungle or woods. The mechanics of the robot uses the concept that has been developed to ensure robust navigation, search, and transportation in rough terrain.

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CHAPTER 4

RESULTS AND LIMITATIONS

RESULT:

The experimental model was made according to the circuit diagram and the results were as expected. The home appliances could be remotely switched over a Wi-Fi network. Both the switch mode and the voice mode control methodologies were successfully achieved. The Blynk application was also successful in displaying the status of every application.

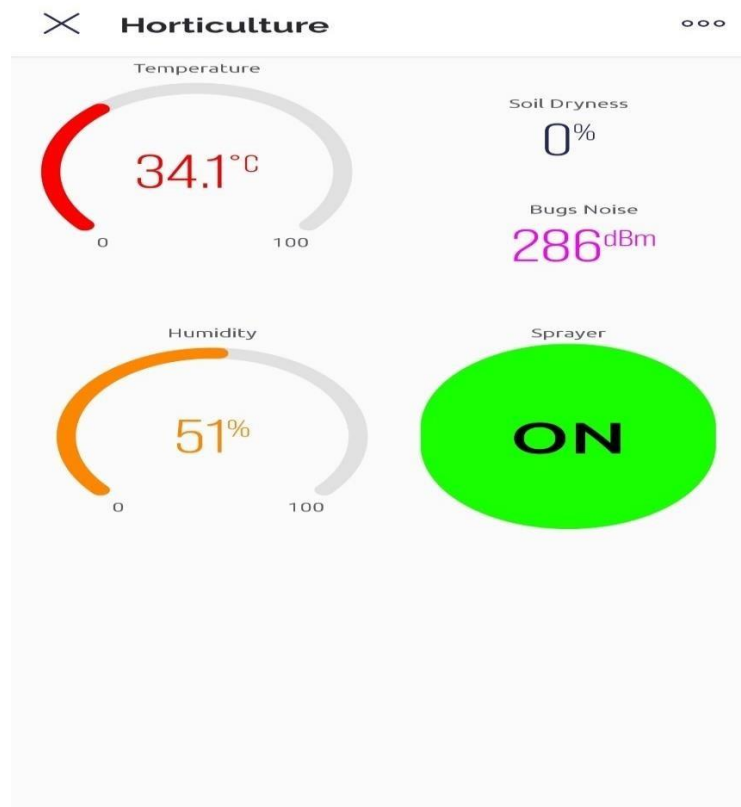


Fig 4.1 Information of garden in mobile application

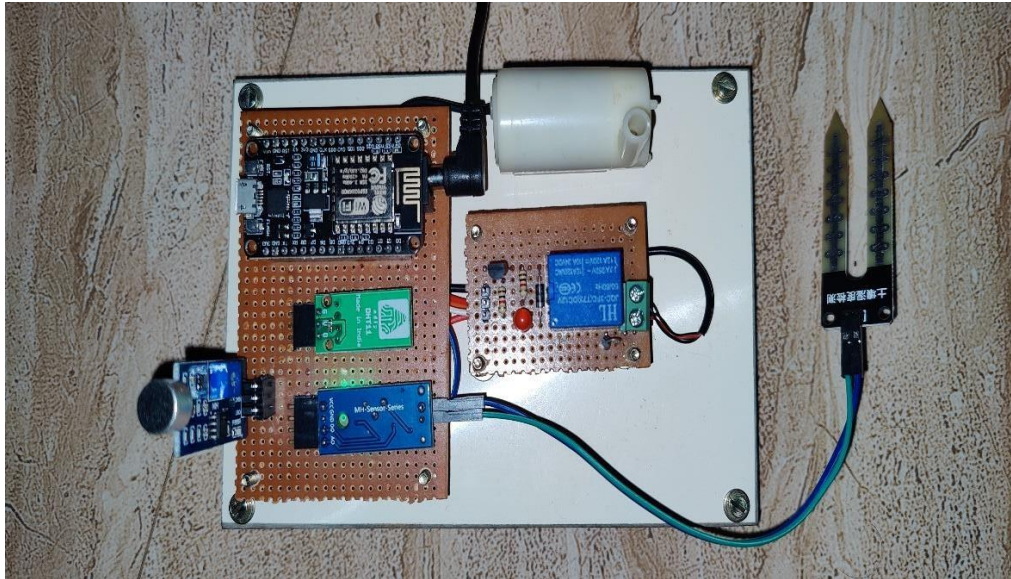


Fig 4.2 Hardware Equipment of Horticulture

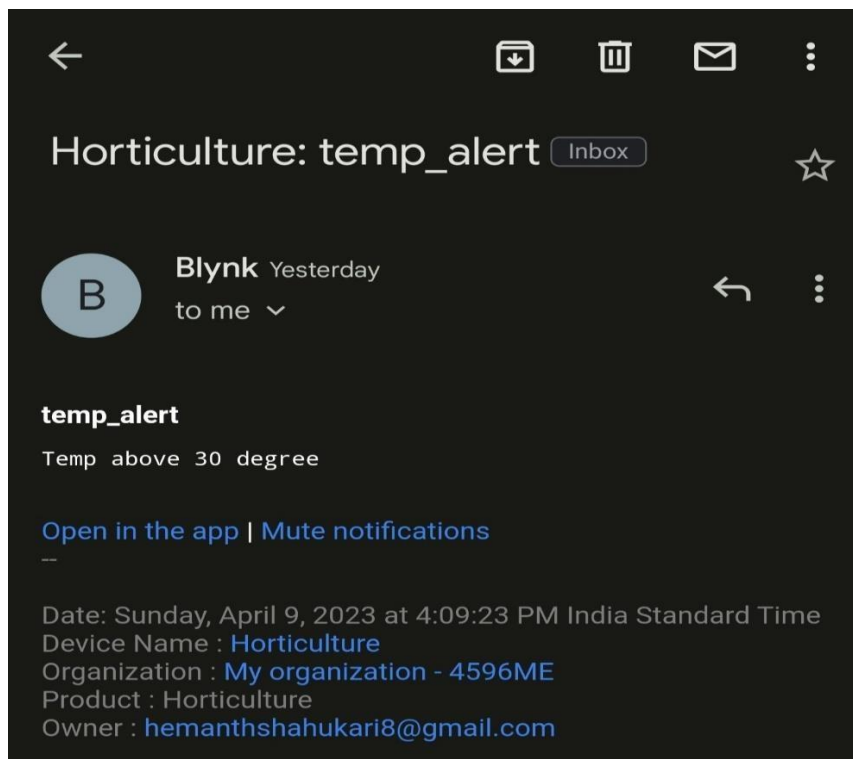


Fig 4.3 High temperature Notification to the owner of the garden

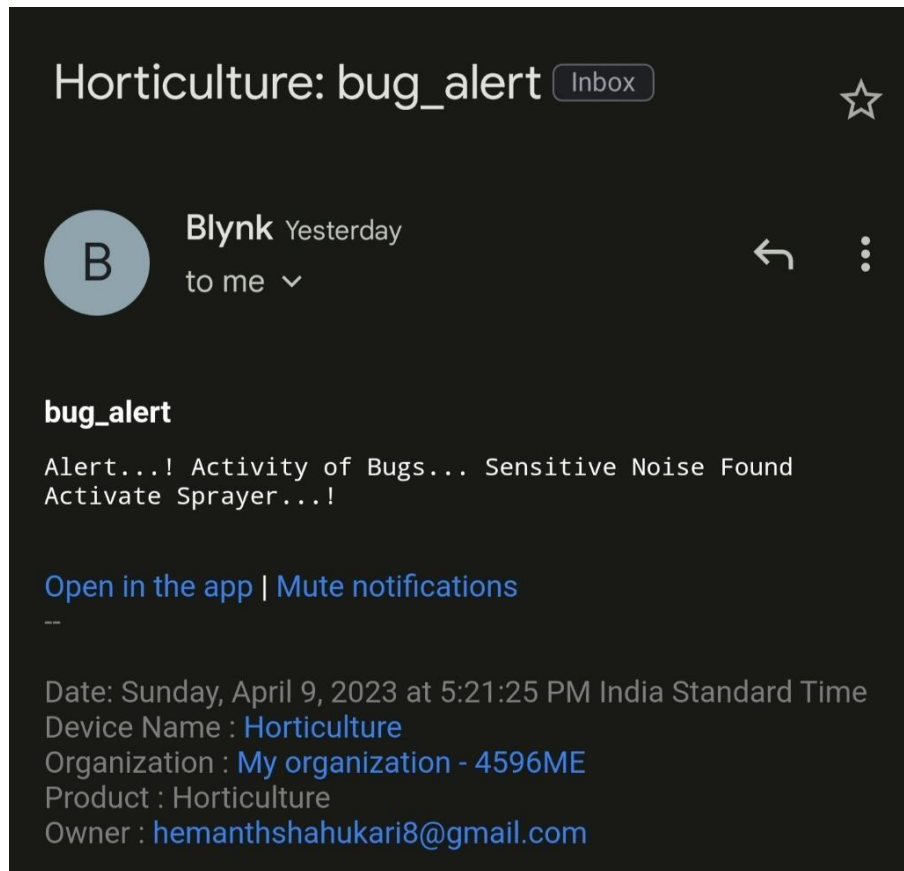


Fig 4.4 Notification Alert for activity of bugs in garden

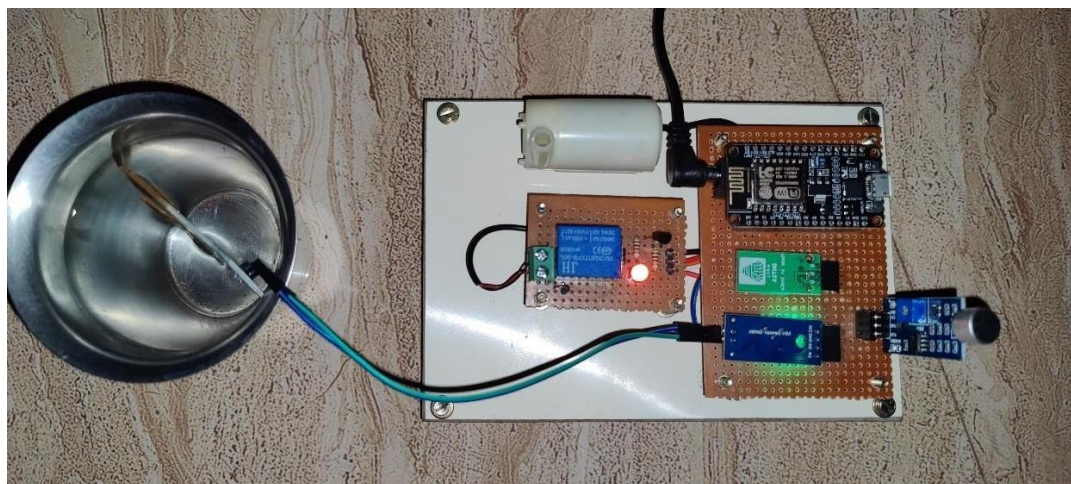


Fig 4.5 Equipment with all the components

LIMITATIONS:

Android devices having a lower API version than 16 require internet access to convert the speech data to string data. Currently, the application is made for Android Smart Phones; other OS platform doesn't support our application. During voice mode, external noises (voice) may affect our result. The speech instruction that we command in our voice mode may not give the exact result as expected. There hence lies an ambiguity in the result.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

CONCLUSION

It is evident from this project work that an individual control home automation system can be cheaply made from low-cost locally available components and can be used to control multifarious home appliances ranging from the security lamps, and the television to the air conditioning system and even the entire house lighting system. And better still, the components required are so small and few that they can be packaged into a small inconspicuous container. The designed home automation system was tested a number of times and certified to control different home appliances used in the lighting system, air conditioning system, home entertainment system, and many more. Hence, this system is scalable and flexible. All the relevant data are updated to the cloud where we monitor the environmental parameters on the cloud web server for the enhancement of the smart agricultural plant monitoring system.

To conclude, this paper presented a proof-of-concept, inexpensive solution for remote monitoring of small to medium-sized, remote greenhouses That can access the Internet, or 4G/LTE access points. Some of the obstacles faced during the design process were regarding cellular communication and weatherproofing the RAHMS client. This has been overcome by using a tunneling service NGROK to expose the camera server to the public network and using an outdoor standard 3D printing filament. In the era of climate change and global warming where controlled-environment agriculture and horticulture are rapidly becoming essential parts of the food-producing industry.

FUTURE SCOPE

For future work, the networking model could be improved by scrapping the server side and introducing a 4G/LTE module. So, the sensor data could be sent directly to the cloud without the need for a Wi-Fi access point. Over-the-air implementation along with UI and image processing improvements in the mobile application would be advantageous. Additionally, a Machine Learning based notification system for diseased plants, an autonomous watering system, and a larger range of sensors to increase the data set for yield prediction are under consideration. As for security, the RAHMS could also implement end-to-end encryption of the data between the communication streams, with unique session IDs per client to prevent spoofing attacks or use unique credentials for each client using a RADIUS server.

Looking at the current situation we can build a cross-platform system that can be deployed on various platforms like iOS, and Windows. The limitation to control only several devices can be removed by extending the automation of all other home appliances. The prototype can include sensors to implement automatic control of the home appliances like; an LDR that can sense daylight and switch lamps accordingly, a PIR to detect motion and be used for security purposes making an alarm buzz, or a DHT11 sensor that senses ambient temperature and humidity of the atmosphere and switch fan/air conditioner accordingly. The scope of this project can be expanded to many areas by not restricting to only homes, but too small offices

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