WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

HydroGenius Smart Drip Irrigation with Automated Weather Adjustment and Comprehensive App Control

Srilakshmi CH[1], Preethi P.M[2], Sanjana C.K.[3], Supriya K[4]

[1]Associate Professor, Department of Computer Science and Business Systems, R.M.D. Engineering College, Tamil Nadu - 601 206, sri.csbs@rmd.ac.in

[2] Student, Department of Computer Science and Business Systems, R.M.D. Engineering College, Tamil Nadu - 601 206, 23202034@rmd.ac.in

[3] Student, Department of Computer Science and Business Systems, R.M.D. Engineering College, Tamil Nadu - 601 206, 23202041@rmd.ac.in

[4] Student, Department of Computer Science and Business Systems, R.M.D. Engineering College, Tamil Nadu - 601 206, 23202052@rmd.ac.in

ABSTRACT -

Introducing HydroGenius Drip Control—the ultimate smart irrigation system designed to transform the way you care for your garden. With its cutting-edge, advanced weather-syncing technology, HydroGenius automatically tailors your watering schedule based on real-time weather data, ensuring that your plants receive the perfect amount of water precisely when they need it. This intelligent system not only eliminates water wastage but also promotes healthier plant growth by delivering the right hydration at the right time. Beyond just automated watering, HydroGenius offers a user-friendly mobile app that allows you to effortlessly control and customize your irrigation settings from anywhere in the world. Whether you're at home, at work, or on vacation, the intuitive interface lets you adjust the duration, frequency, and timing of your watering sessions with just a few taps, while also providing insights into your watering habits and system performance to help you make informed decisions for optimizing your garden's health. By using HydroGenius Drip Control, you're contributing to environmental sustainability by conserving water and saving money on your water bills.

Its precision-engineered technology ensures that every drop of water is used efficiently, resulting in lush, vibrant plants without excess usage. Experience the future of smart irrigation with HydroGenius Drip Control—where innovation meets convenience. Transform your gardening routine, save water, save money, and grow healthier plants with HydroGenius Drip Control. Your garden deserves the best, and HydroGenius delivers it effortlessly.

Keywords-HydroGenius Drip Control; weather-syncing technology; Soil moisture sensor; Temperature sensor; IFTTT Voice Assistant; Weather UPI Application; PIR sensor; Humidity level; Arduino Mega 2560; WIFI Module ESP8266; Relay

I. INTRODUCTION

Introducing HydroGenius Drip Control, the next-generation smart irrigation system meticulously designed to revolutionize your gardening experience by seamlessly blending advanced hardware and software components. This cutting-edge system is equipped with a range of sophisticated hardware elements, including soil moisture sensors that continuously monitor the moisture levels in your soil to ensure your plants are always optimally hydrated. It also features weather sensors that gather real-time data to automatically adjust your watering schedule based on current conditions, preventing both overwatering and underwatering.

The software side of HydroGenius Drip Control is equally impressive. The intuitive mobile or web application serves as your central hub, offering a user-friendly interface for easy control and customization of your irrigation settings. Whether you prefer to manage your garden manually or let the system take care of it automatically, the app provides all the tools you need to ensure your garden thrives. For even greater convenience, HydroGenius integrates with popular voice assistants, allowing you to manage your watering schedules and settings hands-free. Additionally, an IFTTT (If This Then That) account expands the system's automation capabilities, enabling it to interact with other smart home devices and services for a fully integrated gardening experience

II. LITERATURE SURVEY

1. Smart Drip Irrigation System using Raspberry pi and Arduino

Date of Publication: 15th May 2015

Authors: Nikhil Agrawal, Smita Singhal

The document describes a smart drip irrigation system that uses Raspberry Pi and Arduino microcontrollers to automate plant watering, improving gardening efficiency. Users can send an email to the Raspberry Pi, which serves as the central control unit, activating the irrigation system for a specified duration—ideal for those with busy schedules or frequent travel. The Raspberry Pi communicates with Arduino microcontrollers via the Zigbee protocol, allowing for reliable data transfer. The Arduino manages a relay board controlling a solenoid valve connected to a water pump, effectively regulating water flow. Additionally, an ultrasound distance sensor monitors the water level in the storage tank and activates a refill mechanism when it drops below a certain threshold. Designed to be cost-effective, scalable, and energy-efficient, this modular system suits applications from small home gardens to large agricultural fields, enabling easy expansion as needed. Overall, the smart drip irrigation system combines automation and monitoring to provide a user-friendly, efficient, and sustainable solution for plant care, promoting responsible water usage and contributing to healthier plants and more productive gardens or farms.

2. Smart Irrigation System Using Arduino and GSM Module

Date of publication: 23rd October 2019

Authors: Prof. Himadri Nath Saha, Tanishq Banerjee, Suvrojit Kumar Saha, Ayush Das, Arjun Dutta, Anirup Roy, Samabrita Kundu, Arghyadyuti Patra, Arkodip Neogi, Smita Bandyopadhyay, Sampriti Das, Niloy Chakravorty

The document describes a smart drip irrigation system that utilizes Raspberry Pi and Arduino microcontrollers to automate plant watering, enhancing gardening efficiency. Users can send an email to the Raspberry Pi, triggering it to operate the irrigation system for a specified duration, which is particularly beneficial for those with busy lifestyles or frequent travel. The Raspberry Pi communicates with Arduino microcontrollers via the Zigbee protocol, controlling a relay board that manages a solenoid valve connected to a water pump for effective water flow regulation. The system also features an ultrasound distance sensor to monitor water levels in the storage tank, automatically refilling it when levels drop below a threshold to ensure consistent irrigation. Designed for cost-effectiveness, scalability, and energy efficiency, this modular system is suitable for applications ranging from small home gardens to large agricultural fields. Overall, the smart drip irrigation system combines automation and intelligent monitoring, simplifying plant care while promoting responsible water management and contributing to healthier plants and more productive gardens or farms.

3.Development and Performance Evaluation of Automated Irrigation System

Date of Publication: 28th January 2019

Authors: Daniyan Ilesanmi Afolabi, Lanre Daniyan, Khumbulani Mpofu, Ramatsese Boitumelu

The development and performance evaluation of an automated irrigation system was carried out to support all year-round agricultural production. The system offers improved irrigation practices with enhanced optimum water conservation and effective water distribution for increased crop production. It is a general-purpose system which finds application in the irrigation of varieties of crops and farmlands. It also offers an improved means for soil conditions monitoring which is necessary for irrigation scheduling. One of the distinguishing feature of this system over existing is that it affords users the opportunity of querying the system remotely in order to get feedback on the real time soil conditions both on and off the site hence the system is highly convenient, efficient, sustainable, time and cost effective. The performance evaluation of the system was conducted through the irrigation of farm lands of cross section for three soil samples namely; sandy, loamy and clay soil at seven different locations between 8:00-8:59 am. The results obtained indicated that the automated irrigation system offers improved irrigation practices which enhances agricultural productivity and encourages round the year farming.

4. Modeling and Implementation of an Automatic Drip Irrigation System

Date of Publication:26th October 2020

Authors: Sodessa Soma Shonkora, Ayodeji Olalekan Salau

The paper presents the implementation of an automatic drip irrigation system that uses sensors to monitor soil moisture and temperature, and a microcontroller to control the irrigation based on the sensor inputs. The system was modeled using the root locus method and implemented using a PIC16F877A microcontroller, with a graphical user interface developed in Proteus software to monitor the system's operation. The soil moisture sensor and temperature sensor provide inputs to the microcontroller, which then controls the opening and closing of the irrigation valve and the operation of the motor based on predefined thresholds. The system is designed to automatically adjust the irrigation based on the soil moisture and temperature conditions, reducing water wastage and optimizing crop yield compared to traditional irrigation methods. The paper also discusses the software implementation and simulation of the system using Proteus, as well as the results obtained from the implementation.

5. An Effective Moisture Control based Modern Irrigation System (MIS) with Arduino Nano

Date of publication: 16th March 2019

Authors: Komal Kumar N, Vigneswari D, Rogith. C

The paper introduces a modern irrigation system (MIS) that leverages the capabilities of Arduino Nano to implement effective moisture control, aiming to optimize water usage for a variety of crops. This innovative system offers numerous advantages, such as significantly reducing excess water consumption, minimizing the risk of crop damage due to over-irrigation, and automating the irrigation process, which eliminates the need for constant human oversight. Composed of essential components including the Arduino Nano microcontroller, soil moisture sensors that accurately gauge soil moisture levels, relays for controlling the power supply to the pumps, and DC pumps that deliver water to the crops, the system intelligently activates the pump only, when necessary, by continuously monitoring soil moisture levels. This tailored approach enhances the health and yield of various crops while promoting sustainable agricultural practices by conserving water resources. In conclusion, the modern irrigation system significantly improves efficiency and energy savings in agricultural operations, effectively addressing the limitations and challenges posed by traditional irrigation methods and paving the way for smarter farming solutions.

III. EXISTING SYSTEM

The existing systems for irrigation typically involve manual watering methods or basic automated timers that lack the advanced features and intelligence needed for efficient garden management. While these systems have served gardeners and farmers for years, they present several drawbacks:

1. Manual Watering: Traditional gardening methods rely on manual watering, which can lead to inconsistent watering schedules, overwatering, or underwatering, ultimately affecting plant health and growth.

2. Basic Timers: Existing automated systems often use simple timers that allow users to set fixed watering schedules. However, these timers do not account for real-time environmental conditions, resulting in inefficient water usage, especially during rainy days or droughts.

3. Lack of Data Integration: Most existing systems do not integrate weather data or soil moisture levels, leading to potential waste of water resources. Users often lack insights into their garden's needs, making it difficult to optimize irrigation effectively.

4. Limited Control: Many current systems offer limited control options, requiring users to manually adjust settings frequently. This can be cumbersome, especially for those who travel or have busy schedules.

5. No Remote Access: Traditional irrigation systems typically do not provide remote access or monitoring capabilities. Users cannot check or control their watering systems from a distance, limiting flexibility and convenience.

6. Inefficient Resource Management: Existing systems often fail to prioritize water conservation, leading to higher water bills and negative environmental impacts. This inefficiency is particularly concerning in areas facing water scarcity.

7. Lack of Smart Features: Many traditional systems do not utilize modern technology such as mobile applications or voice assistant integration, limiting user experience and ease of use.

In summary, while existing irrigation systems serve basic functions, they fall short in terms of efficiency, control, and adaptability. The HydroGenius Drip Control system aims to address these drawbacks by incorporating technology, real-time data integration, and user-friendly features, ultimately transforming the gardening experience and promoting sustainable water usage.

METHODOLOGY OF APPROACH

A. System Specifications

The software requirements are:

- IOS Android Support
- Cloud storage and Computing
- Weather data integration
- User Friendly interface
- Encryption
- Real Time data storage
- Water usage insight
- IFTTT System

The hardware requirements are:

- ESP8266
- Soil moisture sensor
- DHT11 Temperature sensor
- 1 Channel Relay module
- PIR sensor

- Water pump

B. Architecture Diagram

Architecture diagram is a visual representation of software system components. The below diagram is the architecture of the system.

C. Libraries and Frameworks

The libraries and frameworks used in this system are:

- ESP8266WiFi
- BlynkSimpleEsp8266
- DHT
- BlynkTimer
- WidgetLED
- LiquidCrystal_I2C

D. Data Collection

Data collection is a crucial step in developing a HydroGenius Drip Control. The process involves gathering relevant data from the sensors.

Test Case No.	Module Name	Test Case Description	Input	Expected Output	Actual Output	Test Case Status
1.	Soil Moisture Detection	Verify the dampness from the soil	Senses the mist from the soil	Moisture level detected	Moisture level detected	Pass
2.	Soil Temperature Detection	Test the warmth of the soil	Senses the heat of the soil	Temperature range detected	Temperature range detected	Pass
3.	Water pump function Detection	Test the automatic shut off and open of the valve	Automatic turn off and on by predicting the weather	Automation of Water pump detected	Automation of Water pump detected	Pass
4.	Weather Predicting Detection	Test the accuracy of the weather condition	To notify the user about the weather	Weather forecast detected	Weather forecast detected	Pass
5.	Water level Detection	Test the gauge stage from the irrigation land	When it reaches it limit, the open and close of the water pump is done	Range of water table detected	Range of water table detected	Pass
6.	PIR sensing Detection	Test the human and animal detection over the field	To detect the intrusion in the irrigation process	Animal or human movement detected	Animal or human movement detected	Pass
7.	Humidity Detection	Test the moistness of the soil	Check the level of clamminess in the soil	Moist level detected	Moist level detected	Pass

IV. RESULT AND DISCUSSION

The results that are obtained by the development of application is depicted below:

A. Soil Moisture Sensor

The analysis of soil moisture using a soil moisture sensor that measures from 0% to 100% moisture level typically results in values that represent the volumetric water content of the soil. The specific ranges depend on the type of plants being cultivated and the soil characteristics.

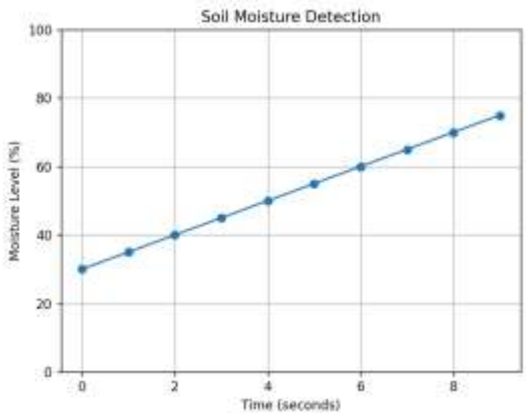
0% - 10%: Extremely dry soil, unsuitable for most plants. May require immediate watering.

10% - 30%: Dry to slightly moist soil, appropriate for drought-resistant plants, but many crops and garden plants would require more moisture.

30% - 50%: Moderate moisture, generally suitable for a wide variety of plants. This range is often targeted in agricultural applications for optimal plant growth.

50% - 70%: High moisture level, suitable for plants that require a lot of water, but it may lead to waterlogging in certain soils.

70% - 100%: Saturated soil, indicating excess water. This can cause root rot, leaching of nutrients, and other issues for most plants.



B. DHT11 Temperature sensor

The DHT11 temperature sensor provides temperature readings in the range of 0°C to 50°C. Here’s how temperature levels can generally be analysed within this range:

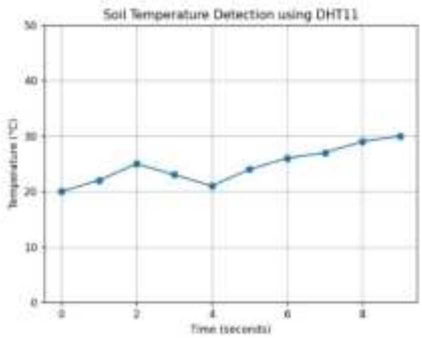
0°C – 10°C: Cold temperature, suitable for plants and processes that require a cooler environment. Some sensitive electronics and crops may be affected by such low temperatures.

10°C – 20°C: Cool to mild temperature. Ideal for many plants and electronics, but certain tropical plants may slowdown in growth.

20°C – 30°C: Comfortable temperature range for most plants, humans, and electronic systems. Optimal for many growth processes in plants and ideal for most sensors.

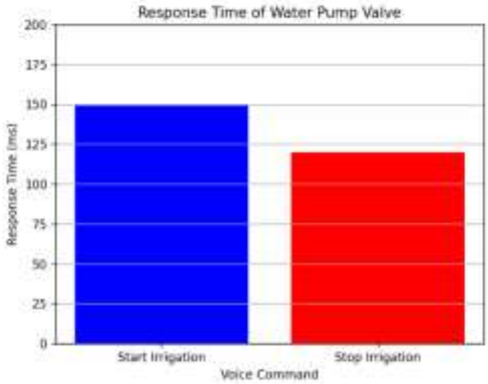
30°C – 40°C: Warm to hot temperatures. Suitable for plants that thrive in hot conditions, but electronics may start facing thermal stress if proper ventilation is not provided.

40°C – 50°C: High temperature, potentially harmful for sensitive plants and some electronics. Prolonged exposure can cause overheating in systems without adequate cooling.



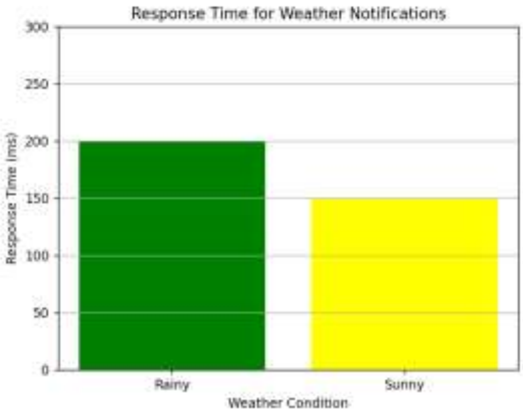
C. Water Pump Valve

response time of opening and closing the water pump valve according to the voice control commands "Start Irrigation" and "Stop Irrigation"



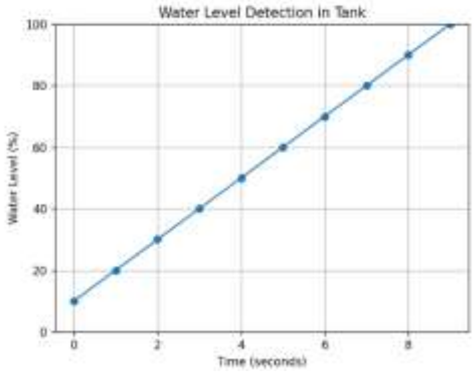
D. Notification

response time of application to send notification regarding the weather forecasted from the live weathermap regarding the weather condition. if it is rainy send notification as "Rain clouds around, No need of Irrigation" and if it is sunny send notification as "It's sunny! your crops need Irrigation"



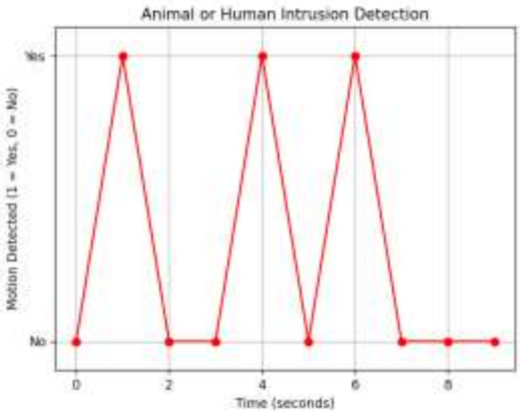
E. Water Level

Water level of the tank is analysed using a water level detection sensor and the results are obtained.



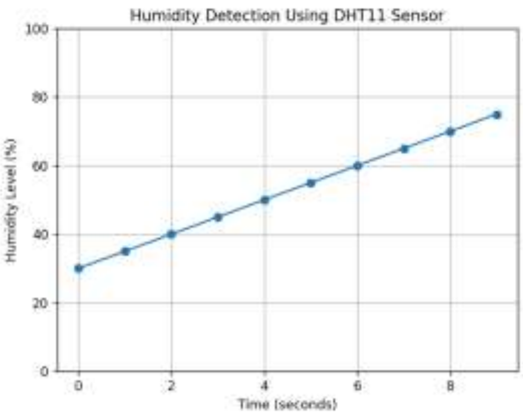
F. PIR Sensor

animal or human intrusion using PIR motion detection sensor. if it is detected send a notification though app as "Alert! Motion Detected" and the led in the app will turn on



G. Humidity Sensor

Similar to temperature the humidity of the atmosphere is also analysed and the results are interpreted.



FUTURE ENHANCEMENTS

- To further improve water efficiency and plant care, the integration of more advanced weather APIs could allow HydroGenius to predict weather conditions and adjust the irrigation schedule even more intelligently.
- With access to hyper-local, real-time weather forecasts, HydroGenius could predict rainfall automatically delay or cancel scheduled watering sessions if rain is expected within a specific timeframe, ensuring no water is wasted.
- **Extreme Weather Alerts** adjust the system’s irrigation based on extreme weather conditions, such as heatwaves, cold snaps, or storms, ensuring plants receive the right level of care during these critical periods.

- **Seasonal Adaptation** that the system could dynamically adjust watering frequencies and amounts based on seasonal changes, ensuring that plants receive the appropriate irrigation for their growth cycle without manual adjustments.
- Moisture-Sensitive Pump Activation in which the water pump can be equipped with a more sophisticated control mechanism that activates based on exact soil moisture levels. If the soil moisture falls below a set threshold, the system could automatically start pumping water until the soil reaches optimal moisture levels. Conversely, if moisture levels are sufficient, it will reduce or halt the water flow to avoid overwatering.
- For larger gardens or agricultural operations, different areas (zones) may have varying moisture needs. The system could use multiple soil moisture sensors distributed across the garden or field, allowing the pump to deliver water only where it is needed and in the precise amounts required. This would lead to highly targeted irrigation.
- Based on real-time feedback from soil sensors, the system could adjust the flow rate of water through the pump. For example, during periods of high evaporation (hot weather), the pump could increase water flow slightly, while cooler, more humid conditions would result in a slower water delivery.
- Based on learning user preferences, historical weather patterns, and moisture data, the system could automatically recommend and adjust optimal watering schedules for the best plant growth. For different types of plants with varying water needs, the system could automatically tailor irrigation settings based on specific plant types (using plant databases) to further optimize water distribution and plant health.
- Enable real-time voice queries like checking soil moisture levels, tracking water usage, or asking whether watering is necessary today based on the weather forecast. Prioritize critical zones or plants during periods of water scarcity.

REFERENCES

[01] J. P. Reganold et al., "Sustainable agriculture", *Sci. Amer.*, vol. 262, no. 6, pp. 112-121, Jul. 1990, [online] Available: https://www.jstor.org/stable/24996835.

[02] Y. Sun, H. Song, A. J. Jara and R. Bie, "Internet of Things and big data analytics for smart and connected communities", *IEEE Access*, vol. 4, pp. 766-773, 2016.

[03] Renkuan Liao b,1, Shirui Zhang a,c,1, Xin Zhang a,c, Mingfei Wang a,c, Huarui Wu a,c,*, Lili Zhangzhong a,c,* a National Engineering Research Center for Information Technology in Agriculture, Beijing Academy of Agriculture and Forestry Sciences, Beijing 100097, China b Department of Biological & Environmental Engineering, Cornell University, Ithaca, New York 14853, United States c Key Laboratory for Quality Testing of Software and Hardware Products on Agricultural Information, Ministry of Agriculture and Rural Affairs, Beijing 100097, China

[04] Achilles D. Boursianis, Member, IEEE, Maria S. Papadopoulou, Antonis Gotsis, Shaouha Wan, Senior Member, IEEE, Panagiotis Sarigiannidis, Member, IEEE, Spyridon Nikolaidis, Senior Member, IEEE and Sotirios K. Goudos, Senior Member, IEEE

[05] Singh, P., & Saikia, S. (2016). Arduino-based smart irrigation using water flow sensor, soil moisture sensor, temperature sensor and ESP8266 WiFi module. 2016 IEEE Region 10 Humanitarian Technology Conference (R10-HTC). doi:10.1109/r10-htc.2016.7906792

[06] Joaquín Gutiérrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garibay, and Miguel ÁngelPorta- Gándara, “Automated Irrigation System Using a Wireless Sensor Network and GPRS

Module,” IEEE Transactions on Instrumentation and Measurement, vol. 63, no. 1, January 2014.

[07] JiaUddin, S.M. Taslim Reza, QaderNewaz, Jamal Uddin, Touhidul Islam, and Jong MyonKim,“Automated Irrigation System Using Solar Power” ©2012 IEEE

[08] Joaquín Gutiérrez, Juan Francisco Villa-Medina, Alejandra NietoGaribay, and Miguel ÁngelPorta- Gándara “Automated Irrigation System Using a Wireless Sensor Network and GPRS Module ” IEEE 2013

[09] Manish Giri, DnyaneshwarNathaWavhal (2013).Automated Intelligent Wireless Drip Irrigation Using Linear Programming. International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)Volume 2, Issue 1

[10] Miranda FR, Yoder RE, Wilkerson JB, Odhiamboc LO (2005). An autonomous controller for site-specific management of fixed irrigation systems.Comput.Electron. Agric., 48:183-197.

[11] Zazueta FS, Smajstrla AG (1992). Microcomputerbased control of irrigation systems. Appl. Eng. Agric., 8(5): 593-596.

[12] B. Astrand and A. Baerdveldt, A vision based rowfollowing system for agricultural field machinery, Mechatronics, vol. 15, no. 2, pp. 251269, 2005.

[13] Devika, S. V.,Khamuruddeen, S. K., Khamurunnisa, S.K., Thota, J. and Shaik, K. Arduino Based International Journal of Advanced Research in Computer Science and Software Engineering, 2014, 4(10),449-456.

[14] Bains, S. P., Jindal, R. K. and Channi, H. Modelingand Designing of Automatic Plant Watering System Using Arduino, IJSRST, 2017, 3(7):676-680.