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Smart and Automated Agricultural Management System Using IoT

D. Thamaraiselvi, R A V S R Vamsi Krishna, Segu Hemateja

Abstract: ***Nowadays, one can observe the arrival of several mechanical techniques in the agricultural sector. To make the technology accessible to everyone at an affordable cost and to diminish workload for farmers by making it easier to control and understandable, there should be the presence of new technology and it is IoT, which is elaborated as Internet of Things. Usually, Internet of Things is defined as the number of gadgets are connected through wireless networks such as Wi-Fi, SIM networks, etc. IoT technology in the agricultural sector might create wonders by reducing the burden for farmers in a great way. Using IoT (Internet of Things), modern wireless devices can be constructed at an affordable cost to farmers across the country. Therefore, farmers could gain high productivity as the tasks are getting easier as well as being completed within a short period. This paper centers around the job of the Internet of Things in agribusiness that prompts brilliant cultivating. The modern technology named IoT not only shows the impact in the agricultural field but also provides several functionalities in other fields. The point of this undertaking is to propose IOT based Smart and Automated Agricultural Management System that records the data of moisture, temperature, humidity, heat index, and water level. In Smart and Automated Agricultural Management System, soil moisture sensor, DHT11 sensor, water-level sensor, and Arduino technology are utilized to simplify tasks by controlling the parameters of crop moisture content, environmental temperatures at appropriate times through the mobile application called Blynk with secured working.***

Keywords: Arduino Atmega328; Blynk, DHT11; ESP826;, Internet of Things(IoT).

I. INTRODUCTION

Internet of things (IoT) is a term that allows us to use technology to work collaboratively, communicate with one another, analyze and produce data from sensors remotely for processing, and reduce the usage of humans by using technology. IoT is rapidly evolving with applications in fields like medical, defense, and agriculture. Its capabilities are limitless and are often used for the event of society to form and to get a better life. To perform any IoT project one must possess knowledge of hardware components and networking, i.e. a way to connect the devices or sensors with the internet. IoT is defined as the connection of things through the internet. IoT isn't a replacement idea, but advancements in hardware technology have made it easier for implementation. After the positive statement of the USA on Auto-ID in 1998, there was excellent growth in this field. IoT with sensor networks gives another gadget to communicate and notice the continuous information in the actual world furnished with mechanization and dynamic cycle. Designing and developing a unique system using IoT to implement in agricultural fields that can monitor the plants' growth remotely and collecting data accurately for mining and analysis of the information is additionally considered to be an essential task. IoT technology is used vastly in agricultural fields for monitoring, predicting, and managing the sensors, agriculture is the main source of income in India. However, only the partial population relies on agriculture as an income.

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* Correspondence Author
Dr. D Thamaraiselvi*, Assistant Professor, Department of Computer Science and Engineering, Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya, Kanchipuram (Tamil Nadu), India. Email: dthamaraiselvi@kanchiuniv.ac.in
R A V S R Vamsi Krishna, B.E Student, Department of Computer Science and Engineering, Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya, Kanchipuram (Tamil Nadu), India. Email: rvamsi0110@gmail.com
Segu Hemateja, B.E Student, Department of Computer Science and Engineering, Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya, Kanchipuram (Tamil Nadu), India. Email: hema2000rebel1@gmail.com

II. LITERATURE SURVEY

Paper 1: "Sustainable Agricultural System Using IoT"
Authors: Ramya Venkatesan, Anandhi Tamilvanan
Description: The authors clarify about a Sustainable Agriculture System Using IOT Developed a framework that will naturally screen the horticulture fields. In addition, performing live data in real-time for observing the farming field through the Raspberry Pi camera. The farming fields are checked for natural temperature, stickiness at the soil moisture sensor. IoT and remote sensor node assists with diminishing the efforts, for noticing the farming fields. IoT additionally keeps away from the deficiency of agribusiness boundaries data set and save in the capacity gadget or cloud for long life. It likewise gives ceaseless checking in all regions. Agricultural growth depends on environmental factors like humidity, temperature, PH of soil, moisture, and so on. The proposed system model is developed to urge more yields by identifying the causes. [1]

Paper 2: "A Low Cost Smart Irrigation Control System"
Authors: Chandan Kumar Sahu, Pramitee Behera
Description: The authors suggest a paradigm in which water flow and direction are monitored and managed. This is managed with the help of two sensors namely DHT11 and soil moisture. This method also proposes a way to select the direction of water and this information is also sent to the phone and Gmail account of the farmer. This model also enables the farmer to modify on and off the motor with a single click. This model is designed in such a way that the number of sensors is placed in different positions of the farm and also shows the advancement in the conventional irrigational system by making it cost-effective and sustainable. The writer created a model which is energy and cost-efficient, and also automated. [2]

Paper 3: "Implementation of Wireless Sensor Network for Real Time Monitoring of Agriculture"
Authors: Apurva C. Pusatkar, Vijay S. Gulhane
Description: The writers zeroed in on utilizing WSN which is Wireless Sensor Network. The utilization of WSN helps continuously check the farming land. This paper mainly focussed and proved that the yield rate in farming became stagnant and hence, they designed a unique device that measures other agricultural parameters like identifying water level and flood, wind direction, wind speed, and weather apart from traditional parameters like soil moisture, temperature, and humidity. The writer incorporated alert functionality, which is sent to the farmer at the time of the alarming situation. The model uses a Global System for Mobile(GSM), ZigBee, General Packet Radio Service (GPRS), Global Positioning System(GPS) for the secure transmission of data. It also recommends installing an automatic system that irrigates the crop with integrated technology, which saves a lot of time, effort, and money for farmers. This aids in raising the crop's productivity by reducing water usage. The proposed irrigation system improves management and sustainability. [3]
Paper 4: "IOT Based Monitoring System in Smart Agriculture"
Authors: S.R. Prathibha, Anupama Hongal, M.P.Jhothi
Description: IoT Based Monitoring System in Smart Agriculture. For Agriculture practice, the farmers are still using the custom strategies due to which, the harvest yield of organic products is very low. This can be improved by utilizing programmed apparatuses. However, by utilizing IoT, we can anticipate the expansion underway with minimal expense by checking the productivity of dirt, humidity, and temperature observing. In the existing system, they are utilizing the customary strategies for future work. [4]
Paper 5: "Smart agriculture monitoring system using IoT"
Authors: N.Sai Harshith, P.Lashitha Vishnu Priya, Dr. N. V. K. Ramesh
Description: The writers explain the Smart Agriculture Monitoring System using IoT. The executed system includes various sensors and devices that are connected by modules. Using the internet connectivity provided by NodeMCU, a client sends the data to and from sensors. Information was monitored through the 'Thing Speak' web page. All the data regarding the water level, its work timings, changes, in time performance of tasks can be monitored by the farmer. Monitoring the growth of the crops is the main functionality of this technology, which helps to get the correct values of different sensors. [5]

III. PROBLEM STATEMENT

There are many working sectors all over the world but among them, one of the important sectors which relate to life is the agricultural sector. Though the agricultural sector is the most important, there was no proper development in it. The growth rate of urban incomes has been faster, and the difference between rural and urban consumption increased slightly over this period.
Despite, rising rural incomes and falling rural poverty, disenchantment with farming has only grown in the countryside due to that the people living in cities are not at all showing any interest in agriculture as they are unaware of the work that is involved in farming. There were some drawbacks in present IoT technologies related to agriculture.

According to the latest research paper, first, the system checks the soil moisture level and if it is less than the thresh hold level then the irrigation system (watering) starts automatically and stops after reaching the sufficient level. The drawback in this system is, when there is a sensor failure, water might flow continuously into the agricultural land which leads to the loss of crops.

IV. PROPOSED SYSTEM

The below diagram is the architecture of our proposed project, which indicates the connectivity of sensors and components. The moisture sensor, DHT11 sensor, ESP8266 module, and overflow sensor (rain sensor) are connected to the Arduino Atmega328 board, the information of the sensors is shown in the mobile application named Blynk. Mobile application gives access to the continuous information monitoring of sensors to the user and also assist farmers to take action to fulfill the requirements of the field manually. In this project, the advancements are made by mainly focusing on three parameters namely security, upgrade, and new feature.
Firstly, the security has been enhanced by an overflow sensor (rain sensor), which activates at the time of sensor failure. Secondly, upgraded the prototype by making a mobile application, that can be used for both monitoring and controlling the sensors manually at the same time and finally, added new functionality of street light (LED light) for better visibility at night.

A. Advantages

1. Live monitoring of crop health with automation of motor and controlling the actions of water level using soil moisture values through an application.
2. Overflow prevention of water at the time of any bad situations like sensor failure, heavy rain, etc.
3. Smart light monitoring which adds more convenience for the farmers at night.
4. Monitoring heat index values can be utilized to protect agricultural land from fire burning.

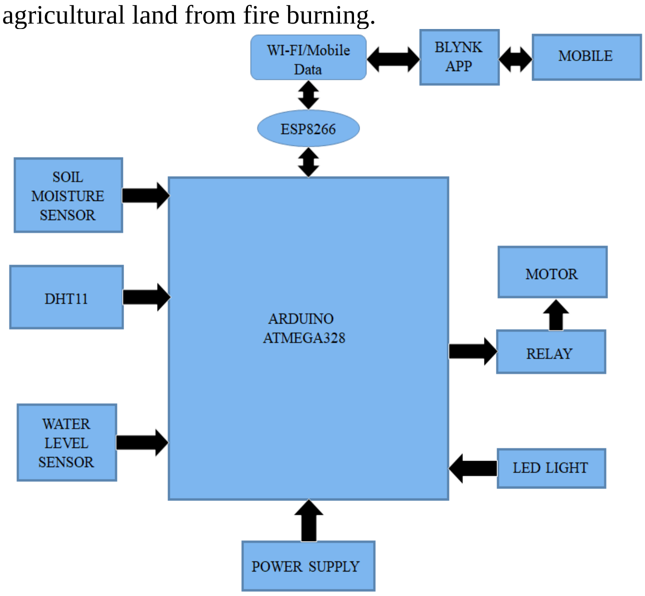

Fig 1. Block Diagram of the Proposed System

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B. Algorithm

Step-1: Start
Step-2: Arduino ATMEGA328 reads the values from the soil moisture sensor, DHT11 sensor, and water level sensor. Live monitoring of soil moisture, temperature, humidity, the heat index is achieved through the Blynk application.
Step-3: If
i) Soil moisture level < 20, then alert message is sent to the farmer and motor gets ON automatically.
ii) Soil moisture level > 90, then intimation message is sent to the farmer and motor gets OFF automatically.
iii) Temperature >=31 degrees Celsius or humidity >= 95 or Heat index >= 50, then an alert message is sent to the Blynk application.
Step-4: When soil moisture is less than the threshold value, then Arduino receives a signal from ESP8266 that is connected to the internet, and Arduino automatically switches on the motor and stops after reaching a certain soil moisture value automatically.
Step-5: Through a mobile application, one can control the motor and can also manage LED light manually.
Step-6: If water overflows due to any sensor failure then a water level sensor is activated and as a result, stops the supply of water, which provides more security.
Step-7: Stop

C. Hardware Requirements

- Arduino UNO
- DHT 11 sensor
- Soil Moisture sensor
- ESP8266 Wi-Fi module
- Water overflow sensor
- DC motor
- LED
- Relay
- Power supply

D. Software Requirements

- ARDUINO IDE
- Embedded C language
- Blynk Android application

V. COMPONENTS AND MODULES

A. Arduino UNO

Arduino UNO is an open-source Hardware board based on the ATmega328P microcontroller. It contains 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, power jack, an ICSP header, and a reset button suitable for various embedded and IoT solutions as shown in Fig. 2

Fig 2. Arduino UNO

B. Soil Moisture Sensor

The soil moisture sensor is utilized to find the moisture level of the soil. Whenever there is a water deficiency then the analog data is sent to the microcontroller from the output module. It has been generally utilized in agriculture, land-water system, and herbal cultivating.

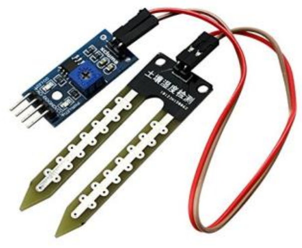

Fig 3. Soil moisture sensor

C. DHT 11 sensor

DHT11 is a small-sized and low-cost sensor that is utilized mainly to detect two parameters of the environment namely temperature and humidity. Apart from these two features, it can also identify the heat index of the atmosphere present around the sensor. This sensor can be effectively connected with any microcontroller like Arduino, Raspberry Pi, Bolt IoT, and so on as displayed in Fig 4.

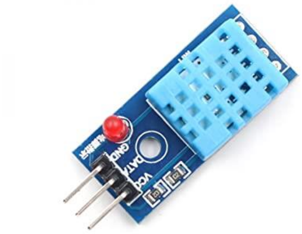

Fig 4. DHT 11 sensor

D. Wi-Fi Module (ESP8266)

ESP8266 is a small-sized Wi-Fi module that belongs to the transmission layer of IoT. The capacity is to change over sequential port into an embedded module that can adjust to Wi-Fi network communication standards as displayed in Fig 5.

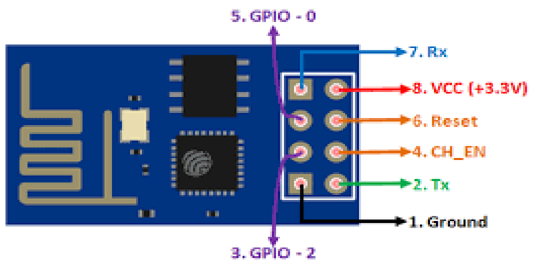

Fig 5. ESP8266 Wi-Fi module

E. Water level sensor

Water is prime and a crucial resource for agrarian and cultivated creation. This sensor senses the presence of water and turns ON instantly upon reaching level 3 and sends the alert message to a farmer as shown in Fig 6.

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Fig 6. Water level sensor

F. Relay

It acts as a switch that works on power.

Fig 7. Relay Module

G. DC motor

It's a portable mini submersible pump that runs on dc voltage. DC motor absorbs the water from the water source and spills them out by utilizing very little power. The disadvantage of this is that failing to maintain the water source higher than the motor might damage the inner parts of the motor as displayed in figure 8.

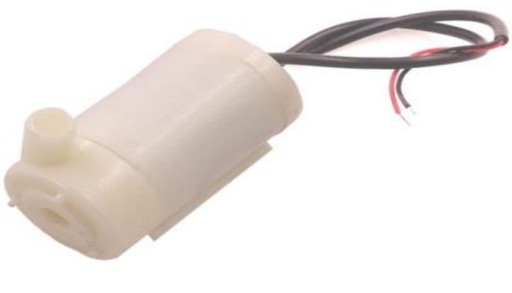

Fig 8. Motor

H. Arduino IDE

Arduino IDE is official open-source software that helps to compile a code. This software can be installed in every operating system. It usually contains a text editor that is utilized to write a code, a hidden console, and a toolbar with some buttons. The programs that are written with this software are referred to as sketches. C or Cpp languages are mostly used for coding in this software.

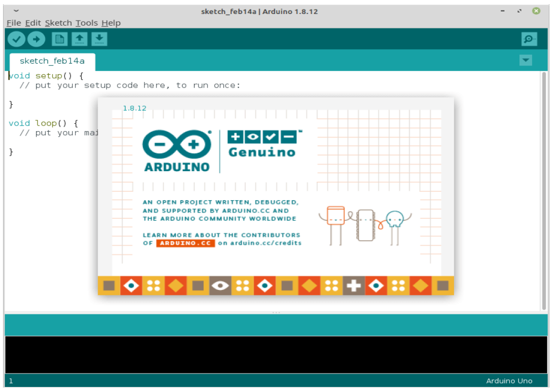

Fig 9. Arduino IDE

I. Blynk Android Application

It was designed for IoT. This software (Blynk) offers the ability to control gear remotely and also displays sensor data. This consists of three main items:

1) Blynk app – This application comprises several widgets that provide an excellent interface to the screen with various functionalities.

2) Blynk Server – This is like a cloud platform that establishes a connection between the Blynk application and microcontroller ATMega328.

3) Blynk Libraries – These libraries include many gadgets that help to make a user interface more interactive, manage incoming & outgoing commands, also play a crucial role in connecting server and microcontroller.

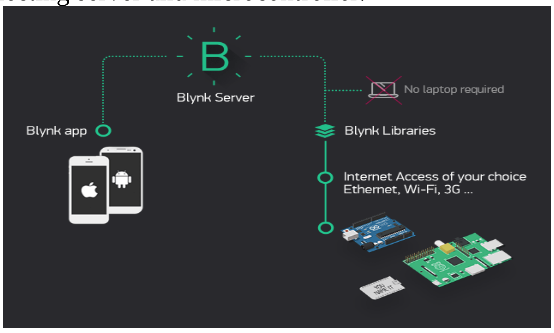

Fig 10. Blynk architecture

VI. EXPERIMENTAL SETUP

Smart and Automated Agricultural Management System experimentally connected and tested. Fig 11 depicts the circuit diagram of the proposed system.

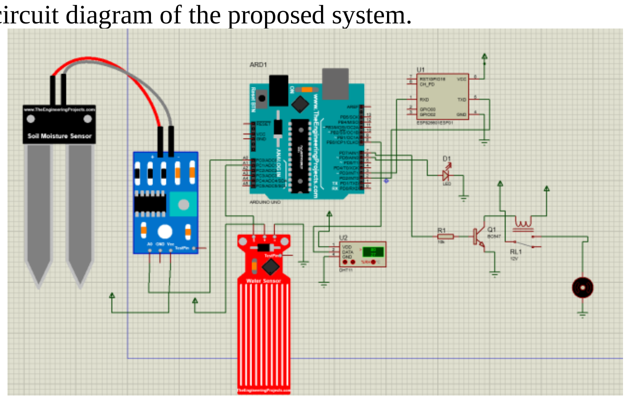

Fig 11. Circuit diagram of proposed system

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Figure 11 shows the experimental setup of our "Smart and Automated Agricultural Management System". Arduino ATMega328 acts as a primary board that receives power supply and is also connected by all other existing devices such as soil moisture sensor, water level sensor, DHT11 sensor, ESP8266 WI-FI module, Relay module, and LED light. The mainboard controls the operations of a motor by using the Relay module as the third party, which means the Arduino ATMega328 makes the Relay module turn ON/OFF, as an outcome Relay switches the motor ON/OFF. Soil moisture sensor and water level sensor send the analog data to the primary board, whereas the DHT11 sensor sends digital data to the same. ESP8266 connects the central board to the WI-FI network to establish a connection with the Blynk server. If the moisture level decreases to a certain limit, the relay gets ON and makes it turn ON the motor automatically, at the same time after getting a sufficient level of moisture, the motor turns OFF automatically or can also be controlled manually using the Blynk application.

VII. EXPERIMENTAL RESULTS

The equipment communicates with every sensor that is in connection with the Arduino Atmega328 board. The controller receives the input from the sensors and transfers the data to the cloud platform named Blynk, where a farmer can check the sensor levels in detail. The results of the experiment depict that the sensors can be controlled manually from anywhere using wireless network technology. The hardware setup and the Blynk interface are shown in Fig 12 and Fig 13.

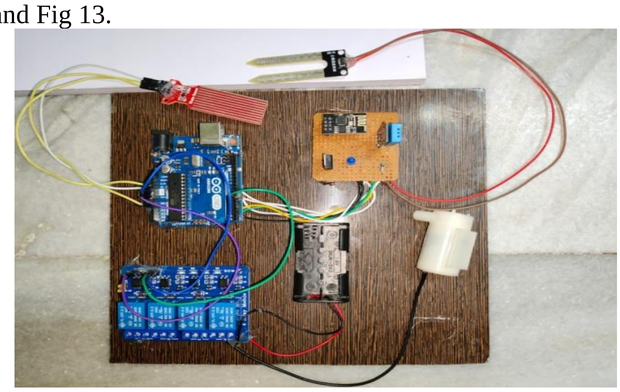

Fig 12. Hardware Setup

Fig 13. Blynk Application

The above Blynk application indicates the data of sensor levels accurately. The program is written in such a way that for every 1 second the sensor readings get updated which provides exact values in real-time. When we supply power to the Arduino board, the Mobile phone gets connected via the Blynk server automatically and notification is sent to the Blynk application as shown in Fig 14.

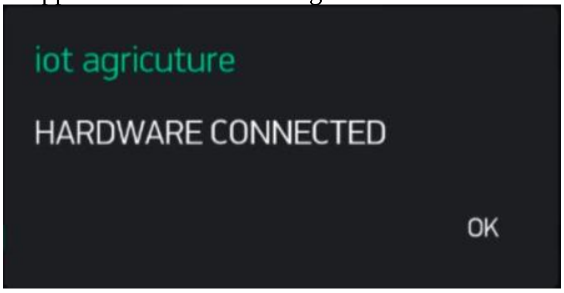

Fig 14. Connectivity Confirmation

When we click the LED button in the application, the LED light turns ON and these actions are illustrated by Fig 15 and Fig 16.

Fig 15. LED Light Button

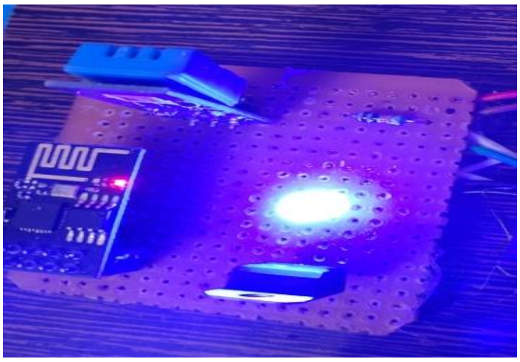

Fig 16. LED Light

When moisture value is less than 20, then an alert message is sent to the mobile phone via the Blynk server, and relay triggers to start the motor as shown in the following figure 17.

Fig 17. Moisture Alert for ON

When we click the MOTOR button in the application, the motor turns ON and water starts flowing through the pipe from water source to plant via submersible pump (motor) is illustrated in the below figures 18 and 19.

Fig 18. Motor Button

Fig 19. Water flows

If the moisture level is greater than 90, then the relay module forces the motor to stop and the application generates an alert notification as observed in Fig 20.

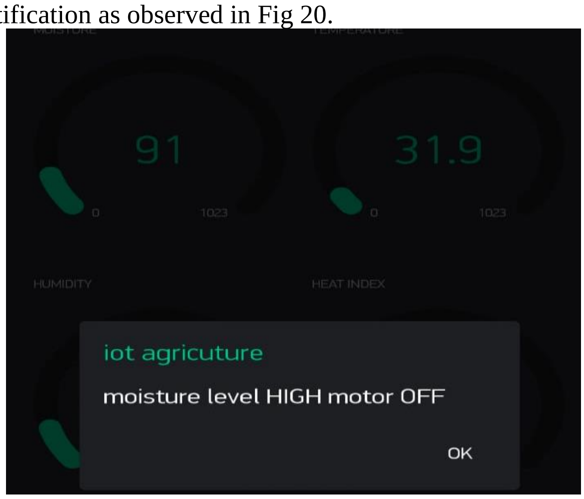

Fig 20. Moisture Alert for OFF

If the soil moisture sensor fails, then water flows continuously into the crop and might cause damage to the crop yield. So, the water-level sensor is kept in such a way that if the water level touches the sensor, then the motor stops, and an alert message is sent to the mobile application.

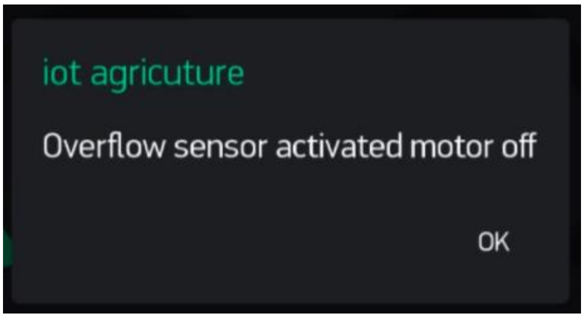

Fig 21. Overflow Alert

Fig 22 indicates that if the temperature, humidity, or heat index values increase in the field either due to excessive heat or fire, then the DHT11 sensor updates the data in the Blynk application and an alert message is generated.

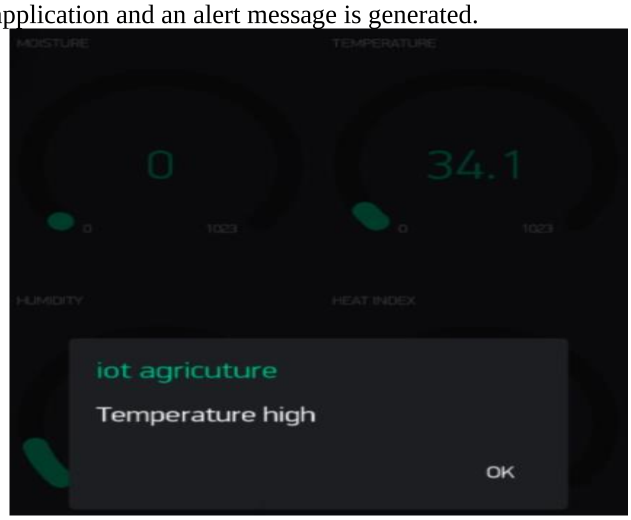

Fig 22. Temperature Alert

VIII. CONCLUSION

Our implemented system assists in monitoring the fields and controlling them using IoT technology. We have reduced the burden for farmers at least to some extent in farming through our device. Monitoring and maintaining the fields using the IoT technology might attract some younger generations and some might show interest and may invest in agriculture. The main function is to monitor the yield development utilizing IoT. With the help of the Blynk app, a farmer can control the actions of a motor pump, LED with his/her mobile. So, there is no need to walk into the field just to ON or OFF the motor. Since most of the monitoring is completed remotely; it helps the farmer to realize information.

REFERENCES

1. R. Venkatesan and A. Tamilvanan, "A sustainable agricultural system using IoT," 2017 International Conference on Communication and Signal Processing (ICCSP), 2017, pp. 0763-0767, DOI: 10.1109/ICCSP.2017.8286464.
2. Chandan Kumar Sahu, Pramitee Behera, “A Low Cost Smart Irrigation Control System”, IEEE sponsored 2nd International Conference on Electronics and Communication System (ICECS2015)
3. Apurva C. Pusatkar, Vijay S. Gulhane, “Implementation of Wireless Sensor Network for Real Time Monitoring of Agriculture”, International Research Journal of Engineering and Technology (IRJET). Volume: 03 issue: 05 | May-2016

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Journal Website: www.ijitee.org

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4. S. R. Prathibha, A. Hongal, and M. P. Jyothi, "IOT Based Monitoring System in Smart Agriculture", 2017 International Conference on Recent Advances in Electronics and Communication Technology (ICRAECT), 2017, pp. 81-84, DOI: 10.1109/ICRAECT.2017.52.
5. Priya, P & Harshith, N & N.V.K.Ramesh, Dr. (2018). Smart agriculture monitoring system using IoT. International Journal of Engineering & Technology. 7. 308. 10.14419/ijet.v7i2.7.10603.

AUTHORS PROFILE

Dr. D. Thamaraiselvi, received her Ph.D. degree in the field of Computer Science and Engineering (CSE) in the year 2019 and completed her M.TECH in the branch of Information Technology (IT) from Sathyabama University, Chennai, Tamil Nadu, India in the year 2010. She is currently working as an Assistant professor in the Department of Computer Science and Engineering (CSE) at Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya deemed to be university, Enathur, Kanchipuram, Tamil Nadu, India. Her areas of interest include Network Security, Machine Learning, Data Science, Cloud, and Internet of Things (IoT). She has got around 10 years of experience in the teaching field.

R A V S R Vamsi Krishna, studied his secondary school certification in DAV Centenary Public School, Visakhapatnam, Andhra Pradesh, India, and pursued his intermediate in MPC domain in Sri Chaitanya Junior College Visakhapatnam, Andhra Pradesh, India. He is currently pursuing his under graduation at Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya (deemed to be university), Enathur, Kanchipuram, Tamil Nadu, India. Out of curiosity he had chosen Computer Science and Engineering (CSE) department in Bachelor of Engineering as his major. His areas of interest include Internet of things (IoT), Full Stack Web Development, Database management, Data structures and algorithms, Computer Networking, Backend development.

Segu Hemateja, studied his Secondary School Certification in Sri Chaitanya Techno School, Vijayawada, Andhra Pradesh, India, and pursued his Intermediate in MPC domain in Sri Chaitanya Junior College, Vijayawada, Andhra Pradesh, India. He is currently pursuing his Under Graduation at Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya deemed to be university, Enathur, Kanchipuram, Tamil Nadu, India. Out of curiosity he had chosen Computer Science and Engineering (CSE), Bachelor of Engineering as his major. He received the top performer batch from Internshala for performing exceptionally well in Java training. His areas of interest include Internet of Things (IoT), Application Development, and Web Development.

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