iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VI **Month of publication:** June 2020

DOI: http://doi.org/10.22214/ijraset.2020.6379

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

Scope of Augmented Reality in Agriculture

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Abstract: ***Augmented Reality, commonly known as AR, and Internet of Things, commonly known as IoT, are the emerging technologies. As many Augmented Reality small scale businesses are growing, many AR devices are being less costly and are affordable by many common people. Augmented Reality has shown optimization in task efficiency majorly in industrial services. However, potential of Augmented Reality hasn't been explored yet. One of the most important sectors is Agricultural Farming. Agriculture Farming is the most important sector because it is the only source of production of food naturally. So, Here I propose an idea where technology can help the sector grow rapidly with an ease.***
Index- Agricultural Farming, Augmented Reality, Internet of Things, Cloud Computing, Machine Learning

I. INTRODUCTION

Augmented Reality, shortly abbreviated as AR, is one of the fastest growing technology in the recent times. Big Multinational Companies including Google, Apple, Microsoft, etc are investing a lot in this technology. Augmented Reality is about projecting a computer generated digital images in a real world. It is of four types namely marker based, marker less, projection based and superimposition based augmented reality. [1]. Augmented reality has already shown its scope in Industrial application, entertainment, robotics, education, etc. With incorporating new technologies with AR, it can be enhanced. Some of the best AR apps include Pokémon Go, Snapchat. Snapchat uses face detection algorithm to detect the faces and then adds the filter on top of it. Google AR Core kit uses plane detection for placing of digital object in a 3D space. Another recent technology that is emerging is Internet of Things (IoT). Internet of Things, commonly known as **IoT**, can be described as the interconnection of smart devices at a remote place [2]. Typically, this remote place can be termed as Cloud. A Cloud is like server that contains many computers at a single place. This cloud is can be used for processing of data that requires high power or it can be used as repeaters, as in communication field. The use of Cloud with other technologies like Cognitive computing that includes Artificial Intelligence (AI) and Machine Learning (ML) can enhance the processing of data with more accuracy. The Internet of Things uses the combination of smart devices that includes microcontroller/microprocessor, various sensors that communicates over internet like WiFi, LiFi, etc. These devices can work without much human intervention and with less human errors [3].

Here, I present the scope of Augmented Reality in the farming field. It can sense the content of essential components in the soil using various sensors. Some of those sensors are discussed in the next section. As each crops require different contents of these essentials, this AgriGlass represents the real time data of these essential nutrients. Additionally, it can also be used for rodent detection and also for monitoring of the farm. [4].

II. DESIGN OF AGRIGLASS

A. Augmented Glasses

Augmented Glasses are wearable computer graphics glasses that includes information or data alongside. In simple terms, it can stated as the glasses with image of information super- imposed onto the field of vision.

Technology is making devices smart. Augmented Reality is at the peak of those technology. In recent times, many start-up forward to utilize this technology. Some of the big MNCs like Apple has shown the prototype of their gadget to be released in 2020. Similarly, Here I produce another such futuristic glass. It is shown below.



Fig. 1. Augmented Glasses

These Augmented Glasses looks like ordinary glasses with several embedded sensors incorporated within. The use of Internet of Things makes the glasses futuristic.

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B. Processor/Microcontroller

1) Qualcomm Snapdragon XR2 5G: Here we propose the use of Qualcomm Snapdragon XR2 5G.



Fig. 2. Qualcomm Snapdragon XR2 5G [5]

The recent release of Snapdragon XR2 shows the possible use in faster AI process. The use of the Snapdragon XR2, also shows the use applicability in AR/VR industry. The above processor comes with 11 times faster AI processing with 4 kryo cores. It supports twice the performance of CPU and GPU from their last released AI processors.

2) NodeMCU: NodeMcu is a WiFi SoC firmware based on ESP8266x. NodeMCU is a SoC designed especially for Internet of Things sector. The micro controller chip included in NodeMCU is a 32-bit RISC based. NodeMCU operates with a clock rated in range of 80MHz to 160 MHz Typical NodeMCU has 128 KB of data memory i.e. RAM and 4MB of program memory i.e. flash memory.



Fig. 3. NodeMCU

Additionally, it supports in-built WiFi which make it ideal for Internet of Things application. [6]

C. Sensor

Some of the sensors that can be used are listed below.

1) DHT 11: DHT 11 is a digital temperature and humidity sensor. Due to its less power consumption and small size makes it ideal for use in projects. [7]. The package comes with 3 pins.



Fig. 4. DHT 11 sensor

The DHT 11 has an accuracy of 5%±RH for humidity calcu- lation and an accuracy of 2°C for temperature calculation.

2) NPK: NPK sensors measures the content of Nitrogen, Phosphorus and Potassium in the soil. The NPK content in the soil can affect the growth of crops.



Fig. 5. NPK sensor

These three elements are essential for the growth of plants. The Nitrogen (**N**) is used in promoting the growth of leaves and vegetation, the Phosphorus (**P**) that promotes the root growth and the Potassium (**K**) that promotes flowering and fruiting [8].

a) pH Sensor: The pH sensor used, is based on traditional pH meter, including, acid-base titration, monitoring pH in an aquarium.



Fig. 6. pH Sensor

The resolution of this pH sensor is 0.02 pH units [9]. The ideal soil should have pH in range of 5.5-7.5±

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3) *Software Design:* The software design of AgriGlass with the sensor incorpo- rated can be shown as below.

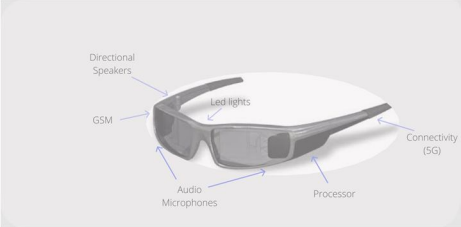


Fig. 7. AgriGlass

III. VERTICAL FARMING

Due to the increasing population and cutting of trees, we require a new farming technique to fulfil over food needs. Recently, environmental obsessions have been mixed with rising obsession with health as architecture design is concerned [10]. This problem is getting worse every year.

Vertical Farming is the solution for the above. The vertical farming architecture is categorized into various sections. Each sections contains separate water supply with less energy re- quirements. The vertical farming architecture is designed that there is sufficient sunlight, artificial or natural, for the healthy growth of crops [11].

It can be shown as below.



Fig. 8. Vertical Farming

IV. MECHANISM

AgriGlass is the futuristic looking gadget incorporated with emerging technologies that includes Augmented Reality, Internet of Things and Vertical farming. The mechanism of Agriglass and scope in farming can be shown as below.

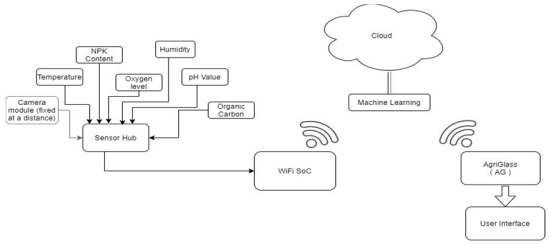


Fig. 9. Block Diagram

The working of each component in the above block diagram is explained as below.

1) *Sensor Hub:* Here, several sensors are built in over the vertical tubes used as for vertical farming that resembles to the squares in chess board game. These sensors includes pH sensor, NPK sensor, Organic carbon sensor, moisture sensor, etc. Each sensors are connected to a sensor hub i.e. all the sensors are connected to a hub that are placed at each column of a vertical farming.
2) *WiFi SoC:* These sensor hubs sends the real-time data of the entire soil/farm onto the cloud using the WiFi SoC. Here, NodeMCU, firmware based on ESP8266, is used.
3) *Cloud:* The term Cloud refers to the remote located Internet Hub. Cloud can provide services over varied networks including VPN, LAN, WAN. Machine learning incorporated in the cloud, classifies the real time data that best suits the soil. The addition of machine learning helps in forecasting the plantation of product that suits the soil according to the climate and soil data.
4) *AgriGlass(AG):* This real time data is received by the AG through in built WiFi. Theses Glasses shows the person the entire farm with their soil information using their augmented UI. It can be used for monitoring and controlling the farm from their glasses.

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V. AUGMENTED USER INTERFACE

Augmented Reality (or shortly abbreviated as AR) is a computer generated information that can be displayed over products/places in the real world. As AR is one of the vast emerging technology, so as the User Interaction (UI) towards AR development.
Some of the successful UI design includes:

A. AR UI in Instagram

The AR UI in Instagram can be best described by the real time filters that it provides.
Some the categories of face filters are:

1) Selfie filter
2) Animals filter
3) Funny filter
4) Sci-Fi filter, etc

B. AR UI in Pokémon Go

Pokémon Go has become the popular game in no time. It uses the mobile camera and places Pokémon's image within the surrounding of the user. The GPS, Accelerom- eter and the compass points towards the nearest Pokémon available i.e. like a game map.



Fig. 10. Pokemon Go

Eventually, all users engage in finding the pokemon with some exciting battles.

VI. RESULTS

A. Hardware Showing Sensor Interfacing with NodeMCU.

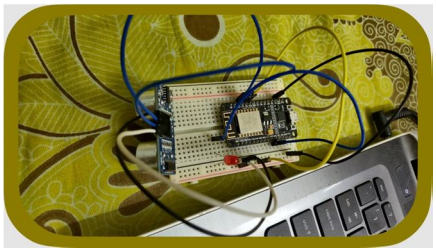


Fig. 11. Distance sensor and LED interfacing with NodeMCU

B. Code for Transmitting data to Cloud.

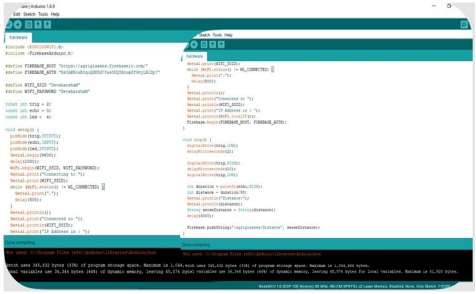


Fig. 12. Code for transmission of real-time data to cloud

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C. Cloud Interface (Firebase).

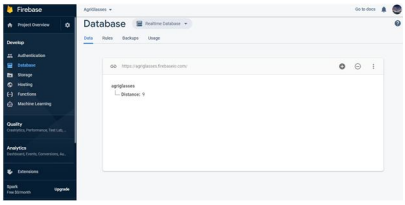


Fig. 13. Firebase interface

D. Machine Learning Program for Classification of Data.



Fig. 14. Deep Learning used for classification

VII. APPLICATION

Some of the applications, where AG can be used are described as follows.

A. Best Suitable Saplings.

The sensors are used to get the information of soil. These data are sent to the cloud and received by the AgriGlass.



Fig. 15. Suitable Saplings based on the Soil data.

The Connectivity and GSM module installed on Agri- Glass can be used to contact the real time data to Soil Research department in order to get the best suitable saplings.

B. Identification of Rodents.

The Camera module is used to monitor in the real time.



Fig. 16. Identification of Rodents.

PIR sensor can be used to detect the movement of Rodents. The PIR sensor doesn't emit any radiation but detects it from the surroundings. Additionally, it gives the distance.

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VIII. FUTURE SCOPE

The addition of Camera, can be used for Rodent detec- tion.Machine learning in cloud can be used for Rodent detection and alerting the person about it.

The Connectivity module in AgriGlass can be made con- nected with a drone. This can help in automatic watering based on the classification of data from farm data.

IX. CONCLUSION

The proposed idea of using Augmented Technology with the future of Vertical Farming can be efficient and handy to use for farmers. Additionally, AgriGlass can save time in monitoring the entire farm.

X. ACKNOWLEDGEMENT

This work was performed under guidance of Dr. Arun M. of Vellore Institute of Technology, Vellore. Author is thankful to VIT (www.vit.ac.in) for supporting and providing the required software's and hardware's for the successful implementation of proposed idea.

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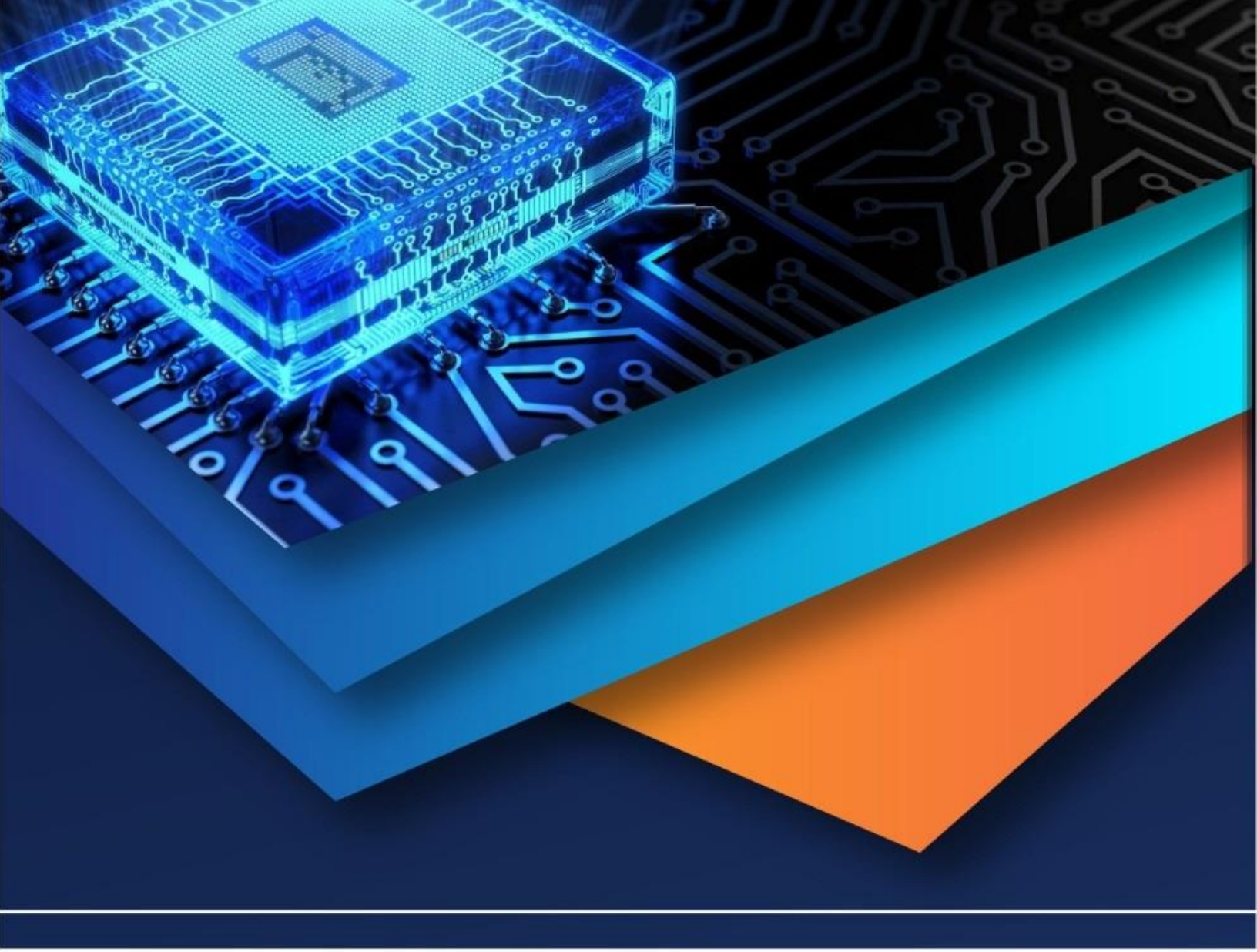
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