Development of IoT Module – Agriculture Solution for Indian Farmers

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Abstract : There is vast enhancement in agriculture sector worldwide i.e. different tools and technologies are being used in agriculture now a days. New technology called Internet of Things (IoT) is used to improve efficiency, productivity, global market and to reduce human intercession, time and cost. IoT is the network of devices which transfer the information without human involvement. Hence, to gain high efficiency, IoT works in synergy with agriculture to obtain smart farming. This paper focuses on use of IoT for agricultural benefits in rural India and also involve one experiment carried out in lab for fertilizer content detection using near infrared laser absorption with its appropriate results.

IndexTerms **- IoT, Smart Agriculture, Sensor Technology, Digital world, Mobile Apps**

I. INTRODUCTION

Development of farming in different phases like survival farming in 18th century, barns farming in 19th century, animal-powered farming in early 20th century and machine powered farming in late 20th century. Now a days an age of data powered farming is coming into picture, via open statistical data sets on climate condition and crop yields, Internet of Things (IoT), smart technologies and drones.

IoT in an agricultural context refers to the use of sensors, cameras, and other devices to turn every element and action involved in farming into data. Remote sensing & IoT are part of new innovations. For example, Science-based analytic tools like FieldScript uses for recommendations on planting, accurate seeding and inherent gain. Monsanto's Integrated Farming System (IFS) used to map and forecast potato yields, farm imagery has been used by GroundCover, With the help of smartphones, CanopyCheck app offers an extra data about geo-location statistics to farmers. To locate the movement and healthiness of cattle as well as for detection of diseases and their prevention, GrowSafe System uses sensors.

1.1 Use of IoT in Indian Agriculture:

India's startup ecology is the 3rd largest technical startup ecology in the world,. 60–65 percent startups are of the Indian IoT system, and 70 percent of them are not more than seven years old. These startups are aiming to the customer as well as agricultural and industrial areas[1].

For small crofters who use sprinkler or drip systems, one of the biggest challenges is to irrigate feild, where water is a limited resource. Contribution of Indian agriculture is 17 percent to the GDP of india and 61.5 percent of Indian population depend on agriculture for their source of income. Drought, lack of reliable labour, and poor frame of infrastructure gives rise to in reduced yield of crop. By combining IoT sensors and activators, can be used to control it remotely by means of mobile applications. To irrigate fields and helping farmers to save water. Solution oriented IoT based Startups like Avanijal has been developed in India to help farmer in irrigation.

Several 24 Indian IoT Startups for agriculture sector has been tracked by India Electronics and Semiconductor Association (IESA), which receive financial help are Wifinity, Nimble Wireless, GOQii, Ducere, SensGiz, Connovate, Systemantics, Ray IT, Ineda Covacsis, ConnectM Eravaku, Altizon, GreyOrange, iIdeaForge, LogiNext, Silvan Innovation, Entrib, Altiux Stellapps, Ecozen , CardiacDesign Labs ,iBoT, and Embrace[2].

1.2 Enter the digital twins:

An exact replica of a physical system which is continuously monitored is nothing but a digital twin. Gartner has identified this digital twin in 2017 as one of the top five trending technologies To monitor agronomic machine efficiency and decrease downtimes, digital models offer deep perceptions on physical asset by continuous learning, For well development of farming machinery digital twins offer very useful competencies.

There are many companies functioning to use IoT in agricultural India, Financial safety to farmers are provided by 12 percent of all IoT startups in India. Agritech company is one of them, SatSure uses IoT to report information irregularity, Gramophone uses IoT technology. Avanijal's app help farmers to save water by irrigating their fields, Smart farm machineries are build by Green Robot with the help of robotics and 3D vision technology. In Indian agriculture IoT Program Green Robot and Avanijal are front-runners in Qualcomm Design, which combine Qualcomm technologies and it's platforms and inspires Indian companies to produce inventive hardware designs [3].

Nowadays application of IoT is a global demand and it is very benificial for the country like India where agriculture is the main source of income and overall development of country. IoT can reinforce the capability of rural populations to become financial carters and worth makers and generate new employment and opportunities. IoT is renovating the farming industry through most innovative and practical applications.

Table 1.1: Summary of IoT applications and their benefits

Sector	***Mobile Application***	***Benefits***
Agriculture	1.GIS system for planning 2.Teleeducation, Scientific databases 3.Telecentres, information services for pricing	1.More awareness of innovative approaches 2.Improved food production 3.Seasonal planning risk mitigation
Animal Healthcare	1.Telemedicine (Audio/Image transmission, Collaboration) 2.Digital publication of medical research 3.Outsourcing of services	1.Increased productivity, reduced travel costs 2.Broader service reach for experts 3.More responsive healthcare

II. THEORY

Things to be Considered Before Developing Agricultural IoT Apps: Farm's performance and revenue can be increased with the help of some smart IoT devices. However, it is not an easy task to develop IoT apps for agriulture. There are certain challenges one should be consider before endowing money in IoT operated farming [4].

2.1. Hardware

To construct an IoT operated app for farming, you require to select the suitable sensors for your device or you have to generate a custom one depend upon your device constraint. The data or info or statistics you want to gather and the motive of your results are the key constraints for your choice. In any circumstance, the decisive parameter is sensors quality for success of IoT product, it depends on the correctness of the gathered data and its dependability [5]

2.2. The Brain

For each IoT operated agriculture solution Data analysis is at the center. If you cannot make perceptiveness of the collected data it will not be helpful for you. Thus, you require to have dominant data analytics capabilities. In order to obtain actionable perceptions based on the gathered data, apply forecasting algorithms and machine learning.

2.3. Maintenance

For agricultural IoT products, maintenance of hardware is a task that is of significant importance, as sensors used in farming field can be broken easily. Hence, you need your hardware which is robust and easy to maintain else, you will in effect change sensors used in farming field more frequently.

2.4. Mobility

IoT operated farming apps should be personalized for usage in the farming land. A farm manager or business owner must be capable to access and control the statistics on site or remotely via desktop computer or a smartphone. Plus, each associated equipments or devices must be self-sufficient and have plentiful broadcast range to converse with the other equipments or devices for sending records and data statistics to the central server.

2.5. Infrastructure

You need a firm central infrastructure to confirm that your IoT operated farming app executes thriving and to making sure about it's data handling capability. Moreover, security of central infrastructure is also a main concern. Failing of the security system of central infrastructure can cause burglarise your data, or someone can also take control of your self-governing system.[6]

III. TECHNICAL Work

The experimental work is based on working principle of "Beer Lambert's law" which relates the absorption of light to the concentration of the absorbing substance in the solution as well as the depth or thickness of the colored liquid.According to the Beer's law, the fluorophore in a translucent solvent absorbs the light quantum that varies linearly with the tester cell path length and the concentration.From the correlation of the light intensity that is incident on the sample (I_0) to the intensity passing through the sample (I), Absorbance (A_λ) is calculated as,

$$A_\lambda = \log I_0 / I \qquad (1)$$

Due to overfertilization of agricultural soil, subterrestrial water also began to become contaminated with fertilizers. It is important to reduce this underground water pollution by increasing the quality of fertilizers and improving the efficiency with which they are applied. An experiment is carried out to verify this

3.1 Tools Required:

1. Near IR Laser Module
2. BPW34 Photo Diode
3. Potassium Dichromate ($K_2Cr_2O_7$)
4. Arduino UNO
5. LabVIEW Software

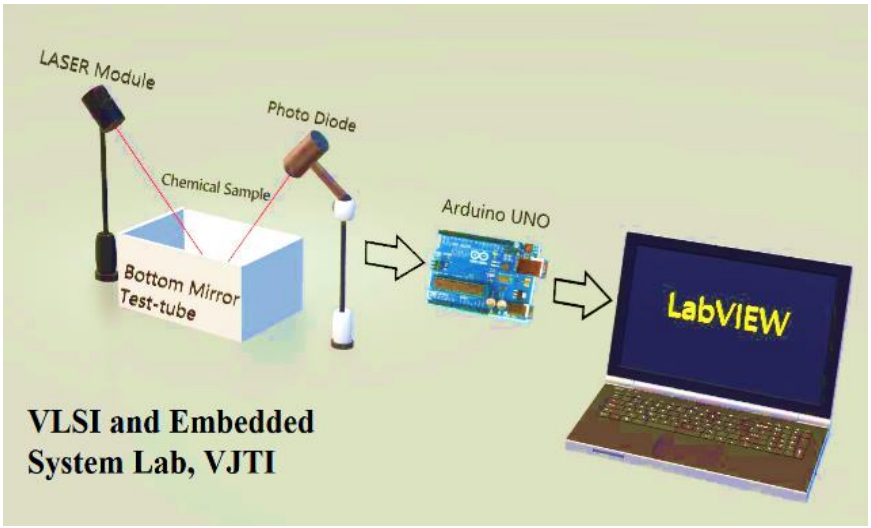

Fig.1.1 Procedural setup of experiment

3.2 Experimental setup:

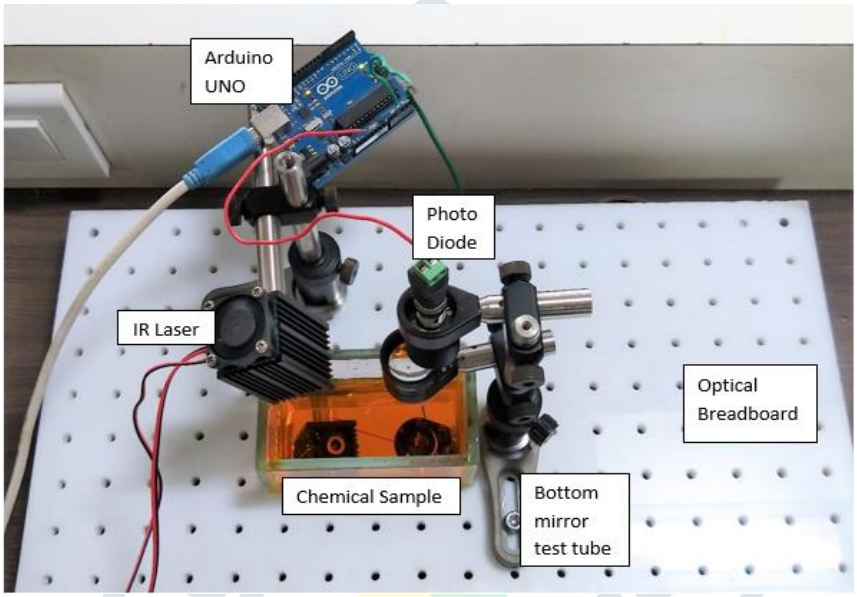

Fig. 1.2 Top view of experimental setup

An arrangement of optical components consisting of laser is used to project the light beam in the direction of test-tube at detector unit which measures the intensity of the light once it is well-versed with the sample.When IR beam interacts with test sample, the scattered light is detected at photo diode. The amount of photon absorption by a sample can be easily found out by calculating transmitted light intensity at photo diode. [7]

3.3 Procedure:

1. Arrange the components as shown in experimental setup.
2. Design experimental block diagram in LabVIEW.
3. Load the graphical program of LabVIEW in Arduino.
4. Select proper serial port and analog channel in LabVIEW.
5. Run the program.
6. Then pass the IR laser through pure water sample (100ml) for some time.
7. Add 10 g of Potassium Dichromate in pure water sample.
8. Observe and record the voltage reading using LabVIEW.
9. Export recorded data in Excel Sheet using LabVIEW.

3.4 Simulation:

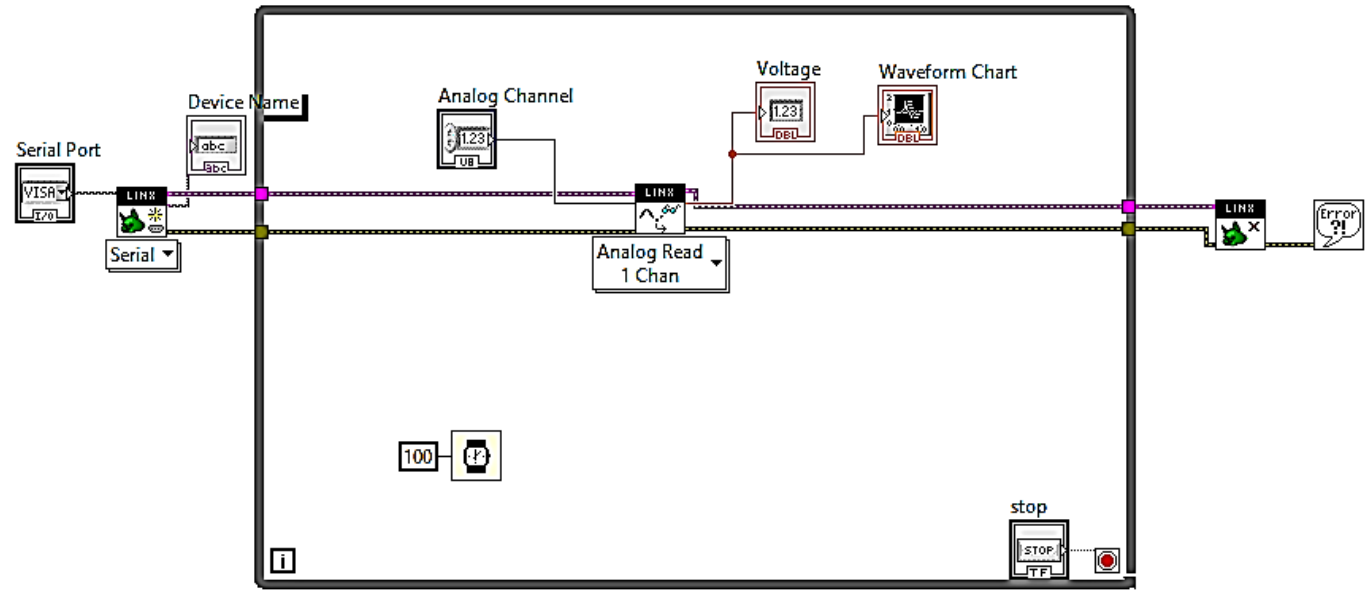

Fig 1.3 Block diagram design in LabVIEW

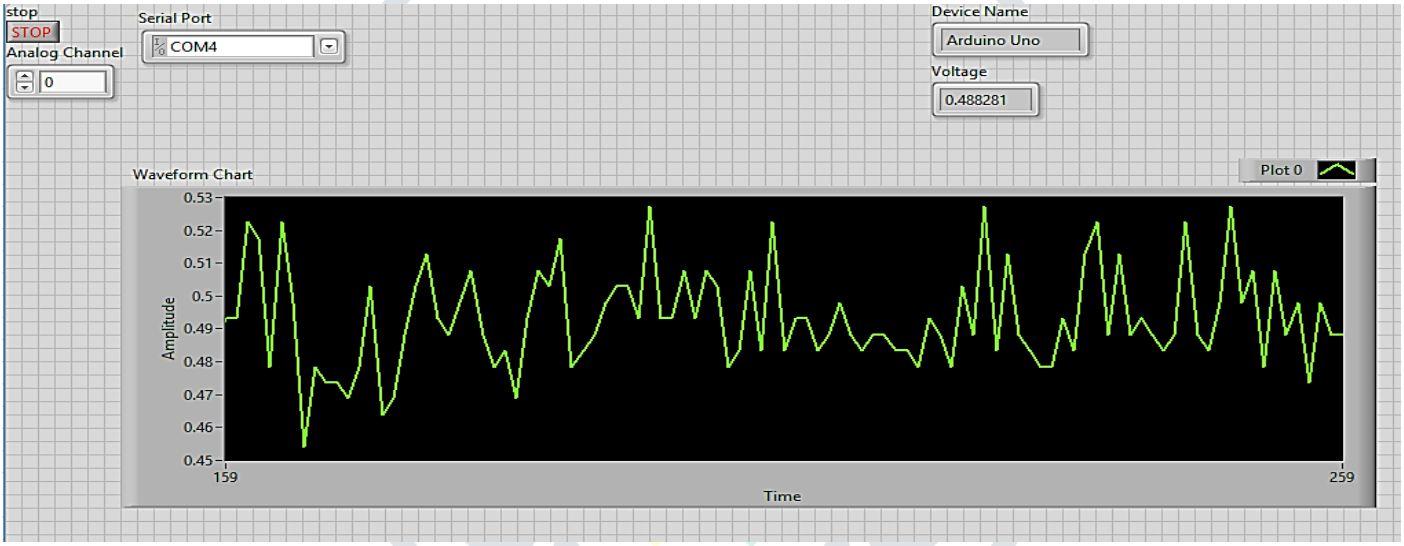

Fig. 1.4 Front Panel in LabVIEW

IV. Result AND Discussion

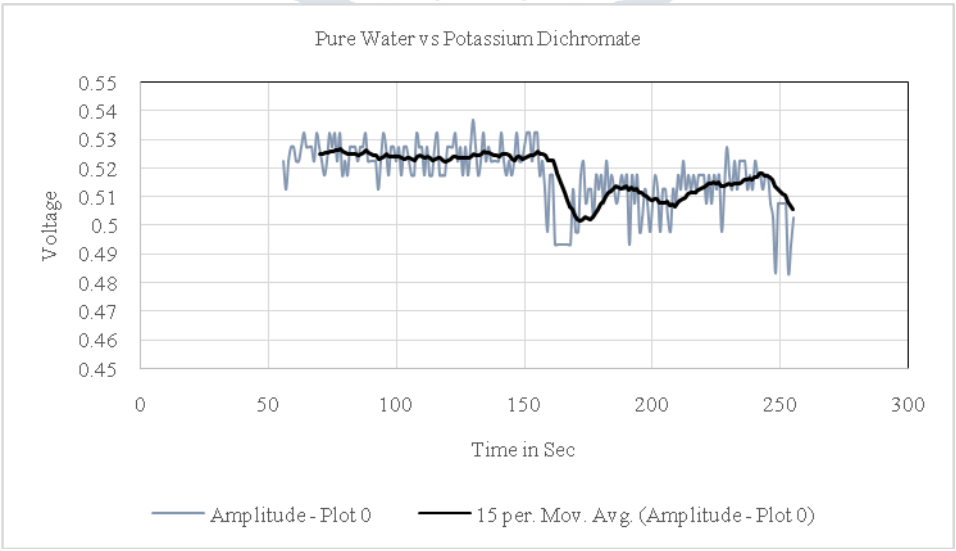

Fig. 1.5 Obtained Graph from experimental setup

The molecules in the sample will start increasing their vibration, when laser beam of specific wavelength is focused on a test sample. The transmitted and scattered beam of light is focused with the help of an optical (converging) lens and is made incident for being detected at the photo detector. For this experiment we have used IR laser module operating at 808 nm having output power of 500mw. We have used potassium dichromate which is use in fertilizer as a sample for this particular test.[8]

We have added potassium dichromate in pure water sample at an instant of 150 sec, and then the graph is drawn from the data obtained by LabVIEW. From the above graph it is clear that there is a voltage drop after 150 sec, which indicate that the certain amount of IR light is absorbed by potassium dichromate molecules.[9] From the potential difference perceived in the graph it is possible to determine the content of specific fertilizer in the soil-water sample. Thus, using the same experimental setup we can find different fertilizer content in soil-water by looking at its photon absorption characteristics.NI LabVIEW software connected with internet are used to analyze this type of experimental results remotely.[10]

V. Conclusion

There are numerous benefits of using IoT in agricultural India such as better control over the internal processes, cost management, waste reduction, increased business efficiency through process automation, enhanced product quality and volumes. As well as all these factors eventually lead to higher revenue. There are many types of IoT applications and IoT sensors which can be used in agriculture to monitor Climate Conditions, Crop Management, Greenhouse Automation, Cattle management and it's monitoring and End-to-End Farm Management Systems.

In upcoming years, we need to do the following things technology should be designed such that which can save water, labour and electricity. Preset schedules can be used to optimise use of water in different seasons. Also, we can design system for fine-tuning water distribution depending on the soil quality. IoT in agriculture can unleash a range of benefits. Productivity of agricultural workers can be increased by automating processes such as remote farming equipment. Remote farming equipment also reduces travel costs in agriculture. For cattle, more receptive healthcare services can be provided which can indicate their health and can be tracked via wireless sensors. In today's era providing the necessary training in the regional language to farmers is call of hour.

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