

# Enabling a Smart Farming System for the Indian Floriculture Industry

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**Abstract**— Indian floriculture industry has grown by multiple folds in the past decade and has become one of the top ten leading producers of varieties of flower production. This tremendous growth of floriculture industry has proportionally also contributed to the depletion of environmental system. The paper proposes a technology-based fertilizer application infrastructure has been designed for an optimal growth of plants under a controlled usage of fertilizers. The model assures a fertigation process with reduced intervals of fertilization and a reduced consumption of water. A technology for fertilizer application infrastructure is based on Internet of Things (IoT) that helps to achieve an optimal growth of plants under a controlled usage of fertilizers and a promised environmental sustainability.

**Keywords** — *Smart Fertigation; Sensors Network; Internet of Things.*

## 1. Introduction

Agriculture has been the backbone of our country. India is a country bestowed with various climatic zones to suit various agricultural practices. Indian floriculture industry has grown drastically in past decades and become one of the top ten foremost producers of variety of flowers including rose, tuberose, anthurium, marigold etc in the world. The urbanization and the improved social outlook in the country have also added to the demand for flower production. On the other side the growth of floriculture industry has proportionally donate to the exhaustion of environmental system. Therefore technological invasions have to be encouraged and implemented to improve the quality of farming and farming community.

## 2. Background Study

Rose is hailed to be the queen of flowers not only owing to its beauty and fragrance but also due to its medicinal benefits. The ideal temperature and the soil conditions of the country have added to the potential growth of the industry attracting a considerable figure of small and marginal farmers. It has also gained insight among the self-employed as a profitable source of income. The demand for cut flowers has visualized a wonderful increase after the commercial floricultural industry explosion to turn into one of the largest export oriented business in country. The aggressive growth of the rose cultivation has been witnessing an alarming source of concern over the unenthusiastic impact on the environmental factors. The floriculture sector is a flourishing agricultural industry. Because of vast unexploited arable land, suitable climatic conditions, plenty of low-cost labour market and attractive investment incentives in the country, the industry is developed in unexpected high speed in the last years. The floriculture industry alongside the associated industries created job opportunities for thousands of individuals. Moreover, the

industry supports the country to expand the export items to international markets and SO generates huge quantity of foreign exchange earnings for the economy of the country. Precision farming is been utilized in agriculture from previous couple of years. It's a way to form the procedure of farming more precise and accurate. The key components used for precision farming are automated hard wares, wireless sensors, robotics, etc [5]. Although, significant contributions to the country's economy, the industry is affected by improper infrastructure development and is related to negative environmental and social impacts which can negatively impact the longer term development of the world within the country. Therefore, all stakeholders involved in the sector should give due attention in the implementation of guidelines and rules to minimize the negative impacts of the industry [3].

## 3. Research Methodology

India is in an enviable position to become a pacesetter within the world floricultural trade due to the prevailing congenial location, overall favorable climate of liberalization and globalization and also specific incentives by the govt and floricultural development [4]. The environmental impact of rose plantation has been the extensive use of natural resources. The inappropriate usage of chemicals had been considerably polluting the basic natural resources such as air, water and soil. Since the fertilizers and pesticides applied are easy to be washed off they enter the soil and water bodies. There are more probable ways that these chemicals leech in to the soil contaminating the underground water. The rich usage of nutrients leads to eutrophication where these excess nutrients washed off from the rose fields lead to an enormous growth of unwanted plants. Furthermore the polluted environment is lethal to human beings and animals. Air pollution is another main concern due to the intensive use of pesticides. Only 0.1% of pesticides attain the intended goal whereas 99% of them turn out to be air pollutant poisoning the atmospheric air and leading to

global warming. The intensive use of natural resources, hazardous management of fertilizers, and irresponsible disposal system of waste products few of the many reasons for the environmental impact. According to statistics, agriculture uses 85% of obtainable freshwater resources worldwide, and this percentage will still be dominant in water consumption due to increase and increased food demand. There is an urgent need to create strategies based on science and technology for sustainable use of water, including technical, agronomic, managerial and institutional improvements [10].

The study on the production costs incurred by the rose farmers highlighted the significance of chemicals in rose production. The farmers expressed that the major share of the production cost is incurred on the fertilizers and plant chemicals. The production cost of rose cultivation was calibrated and shown in Table-1. But there was no visible technological contribution to control the pest and improve the production of roses. The table manifests the significance of the chemicals on the growth of plants.

**Table 1: Significance of Chemicals on plant growth**

S.No	Categories	Cost Percentage Incurred
1.	Cost of fertilizers	17%
2.	Cost towards Pest Control or plant diseases	15%
3.	Cost towards plant protection chemicals	08%
5.	Cost towards disease control	30%
6.	Other expenses	60%

Depletion of ground water levels has been another challenging factor to the farming industry. The drip irrigation system has been broadly implemented for effective usage of water sources. The chemicals for the plants are also infused through the drip pipes at regular intervals. Therefore the technology for a controlled chemical infusion required to be incorporated in the drip irrigation mechanism. The fertigation is a method of injecting fertilizers required for a plant growth directly into the drip irrigation system. The fertigation process helps in equal distribution of water and the fertilizers. The composition and quantity of nutrients, and the period of its application is very crucial for the plant's growth. The smart fertigation process helps in providing a balanced nutrient dose to the plants. A technology for fertilizer application infrastructure based on Internet of Things (IoT) can be implemented for an optimal growth of plants under a controlled usage of fertilizers. The Smart agricultural system can prove to be helpful for farmers. But In the present situation it has been realised that the use of inorganic fertilizers should be integrated with renewable and environmental friendly organic fertilizers and green manures [2].

#### 4. Design of the Smart System

The technology-based fertilizer infrastructure has been designed for most favourable growth of plants under a controlled usage of fertilizers. The work studies the growing stages of the plants, flowering patterns and its associated environmental factors. The dependency of fertilizers and insecticides during each stage of the plant development is monitored and a smart fertigation infrastructure is built to automate the process of feeding the plants with appropriate chemicals at appropriate intervals. The proposal emphasizes on environmental sustainability by a smarter way of fertilization and pest management techniques in rose cultivation. The technology has been developed to observe the direct and indirect impact of the aggressive growth of rose farming on the environmental factors. Moreover, Internet connectivity became the norm for several business applications and is today integral a part of many enterprises, industrial and consumer products to supply access to information. However, the web usage still primarily focuses on human interaction and monitoring through apps and interfaces. A more intricate approach to IoT products in agriculture can be represented by the farm productivity management systems. It usually include several agriculture IoT devices and sensors, installed on the premises as well as a powerful dashboard with analytical capabilities and in- built accounting/reporting features[8].

The model shown in figure 1 shows the flow of data after being analysed by the sensors. A smarter fertigation helps in providing a balanced nutrient dose to the plants. The sustainability of the system proposed assures optimal utilization of resources such as water, soil and nutrients. The soil constitutes the Nitrogen, Phosphorous and Potassium as its main nutrients. These components determine the fertility of a soil. The extensive use of rose plants exhausts these nutrients and had to be supplied as fertilizers. A balanced nutrition is crucial for the growth of a plant and quality of flower yield. While the reduction of one of the nutrient might result in poor development of the plant, overfeeding of nutrients leads of stagnation of salts and soil wilting. The crop response to fertilizers varies with its type and mode of application. The current work narrows down to handle the environmental hazards of rose farming in the floriculture industry through technology-driven fertilization process.

#### 5. Implementation

The project proposes a SMART IOT- based fertilizer application infrastructure for a growth of plants under a controlled usage of fertilizers. The model assures fertigation through reduced intervals of fertilization and a reduced consumption of water. A smarter fertigation helps in providing a balanced nutrient dose to the plants. The sustainability of the system proposed assures optimal

utilization of resources such as water, soil and nutrients. Adequate water system is an essence for agriculture and therefore the crops are often damaged in either of situation of more than water system or in shortage of water system. In drought condition, IoT can establish to be a great value as it manages the limited water supply with least wastage of water resource [9].

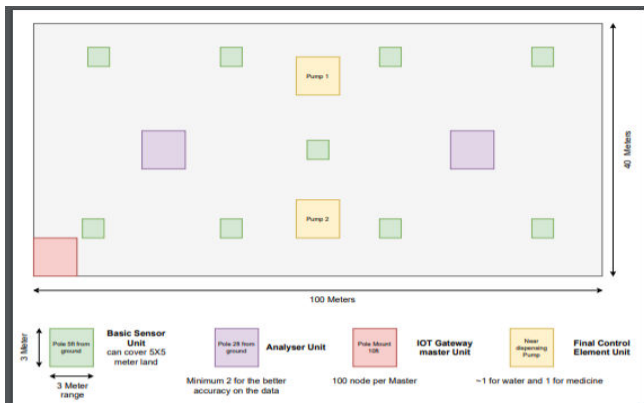


Fig. 1: Basic Model of Fertigation Data Flow

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The architecture of the sensor technology in to the farming is shown in figure 2. The initial process is to test the moisture, temperature and PH of the soil by the SMART Basic sensor unit and will deliver a command to the IOT gateway master unit in response will trigger a SMART actuator unit to supply the enough water by the dispenser pump to the landside.

The SMART analyser unit as two parts, the first part one will sample the soil which capture a image by an HD camera and manipulates the present soil status will compare with the data sets which thought to the system by machine learning. and will produce a consolidated result to the IOT gateway master unit and save it as data point 1.

The second part will sample the plant growth status by capture a image by an HD camera of the plant and manipulates the present plant status will compare with the data sets which thought to the system by machine learning,

and will produce a consolidated result to the IOT gateway master unit and save it as data point-2. Based on the two data points the IOT gateway master unit find the best solution and composite fertilizer required for the plant and soil, in turn will trigger a SMART actuator unit to supply the required fertilizer by the dispenser pump to the landside.

The IOT Gateway master will update the entire system and event status to the user by the way of SMS and by electronic mail. The system also provides a the stackable feature for maintaining multi-location farms in a centralized web page which can be utilised at later stages of the development of an IOT SMART Farming project.

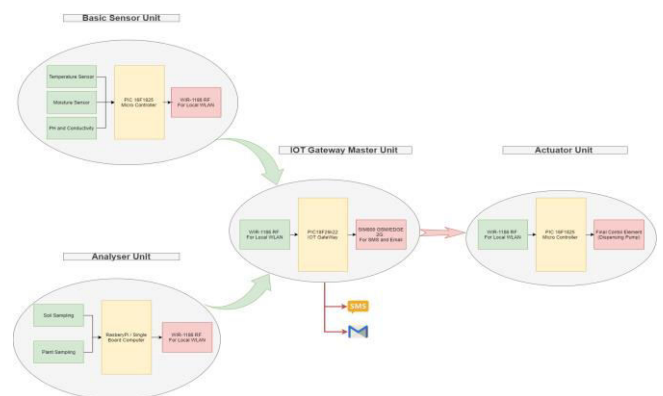


Fig. 2: Architecture of Sensor Technology

## 6. Results and Discussion

A new paradigm called social IoT (SIoT) considers social relationships between objects the same way as humans form social relationships. Here are the three main facets of an SIoT system: (i) The SIoT is navigable. We can start with one device and navigate through all the devices that are connected thereto. it's easy to get new devices and services using such a social network of IoT devices. (ii) A need of trustworthiness (strength of the relationship) is present between devices (similar to friends on Facebook). (iii) We can use models almost like studying human social networks to also study the social networks of IoT devices [7]. The technological intervention into the floriculture farming system assures better scope of increase in the productivity. The increase in production and profit can improve the living conditions of the farming community.

The discussion with the farmers showed their enthusiasm to learn and adapt to modern technologies. With more demand for the commercial crops the farming community is looking forward for new horizons of productivity in agriculture. With the advent of enthusiastic younger generation into farming, the technology-based farming would pave for more quality controlled and environmental friendly agricultural system. Internet Of

Things (IoT) is a shared network of objects or things which may interact with one another provided the web connection. IoT plays a crucial role in agriculture industry which may feed 9.6 billion people on the world by 2050. Smart Agriculture helps to reduce wastage, effective usage of fertilizer and thereby increase the crop yield [1]. At present, the key issue in the current domain is utilisation of resources like man-power and water which is lacking in many parts of the country. There have not been any significant technological advancements being made in agricultural sector as compared to other sectors. Agricultural system should be monitored regularly. The use of the developed framework is to reduce wastage by automating the entire agricultural system [6].

## 7. Conclusion

The rapid growth of sensor network can be a revolutionizing the farming industry. The technology discussed observes the direct and indirect impact of the aggressive growth of rose farming on the environmental factors. The dependency of fertilizers and insecticides during each stage of the plant development is monitored. The development stages of the plants and their flowering patterns and the associated environmental factors have been analysed and a smart fertigation infrastructure is built to automate the process of feeding the plants with appropriate chemicals at appropriate intervals.

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