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Data-Centric Approach to Agriculture

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Abstract: Agriculture not only contributes to a considerable portion of India's income but is equally significant for human endurance. The people whose livelihood depends on this are farmers. It has not proved very profitable for them due to various factors such as crop wastage, insufficient knowledge, etc. The sole reason for wastage is using traditional techniques, i.e. relying on the previous most profitable yield and continuing the same throughout. Here, the farmer assumes that the parameters of their farm have not changed. This assumption is wrong as the farm parameters change after every cycle. This assumption leads to lower yields every following cycle and deterioration of the farm. Further, insufficient knowledge includes not just a lack of knowledge about their farm but also, the methods used to improve their farm. Utilizing IoT and Machine Learning techniques to solve these problems implies an efficient solution not only solves their current problems but empowers them by providing sufficient knowledge of their farm parameters, techniques to employ for increasing farm productivity, etc. Employing these techniques increases farm productivity in the long run as the recommendations provided by performing computations of the farm data are personalized for that particular farm and not generalized.
Keywords: data, agriculture, machine learning, prediction, sensors

I. INTRODUCTION

With 58 percent of India's population relying on agriculture as their primary source of livelihood, it is essential to ensure the process is efficient. [2] Looking at the current agriculture scenario, the techniques employed by farmers are the cause of it not being lucrative for them. Relying on traditional yield results for choosing the crop to be grown for the next cycle is a wrong way of going about it as it does not consider the variability that arises in the farm parameters. Further, using the same quantity of resources that led them to a previous profitable cycle does not imply that it will work every time. Instead, turning the focus towards the farm parameters is the ideal step, as it incorporates the in-field variability, which is the most important factor to be considered when making future decisions.

Research conducted by the United Nations' Food and Agriculture Organization suggests that at least 40 percent of food produced in India is wasted before it reaches the consumers. [5] The major contribution to the wastage observed is crop diseases that occur due to reasons such as excessive usage of fertilizers, natural resources, pesticides, etc. As mentioned above, farmers use these resources based on their previous experiences and not what the farm requires, which contributes to crop wastage. Using IoT devices such as sensors to collate data and feeding them to computational Machine Learning techniques assist the farmers with making future decisions. This solves the farmer's problems of not incorporating their farm parameters and enables them to make decisions based on their farm data. Using sensor-collected data for selecting the crop to be cultivated, predicting the likelihood of disease, finding anomalies in their farm parameters solves the above-mentioned issues. Further, using this data improves the knowledge of the farmers in general as they are making data-driven decisions which increases their chances of profitability, improves their farm potency, etc. This is a very good situation for the farming scenario in India as it solves the most prevalent problem of inadequate knowledge.

Section II presents the existing system trying to solve similar problems. Section III provides a brief description of the proposed system. Further, Section IV describes the implementation process of the same. In the last section, the conclusion of the system is described.

II. RELATED WORKS

A. Soil Health Card [4]

This is a report provided by the Indian Council of Agricultural Research that analyzes information based on 12 parameters that include Macronutrients, Secondary nutrients, Micronutrients, Physical parameters, etc for providing recommendations to the farmers. Using this information, farmers can make future decisions. It is a great initiative, but it has a few drawbacks. Firstly, it is a detailed report about the farm parameters and their data. In India, there are very few farmers who are educated enough to understand these reports properly. Secondly, the scale at which this is done does not provide farm-specific recommendations. In a farm stretch of 15 hectares, data of a hectare is used based on which recommendations are provided.

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B. FlyBird Innovations [5]

It is an agricultural company aimed to leverage technology to solve agricultural problems. Currently, their focus is on irrigation services. [5]

Previously, the farmers used to provide water, based on their previous experiences, rather than considering the amount required by the farm.

It proposes 3 techniques to solve this:

1) *Volume-based:* The amount of water to be supplied is fixed in the system. The problem of employing this technique is that it does not incorporate the in-field variability.
2) *Sensor-based:* Using this, the control of farming and irrigation is provided to the farmer
3) *Timer-based:* Using the farmer's requirements, the time provided by the farmer is the period for which irrigation is done

It does solve the previous problem of not incorporating the in-field variability. The core problem of inadequacy of knowledge is not solved here as farmers are still out of the loop.

C. vDrone Agro [6]

It provides farm information captured using drones. It is an efficient solution, but the path from having data to generating insights from them is the one where there is less assistance which is a major drawback.

III.SYSTEM ARCHITECTURE

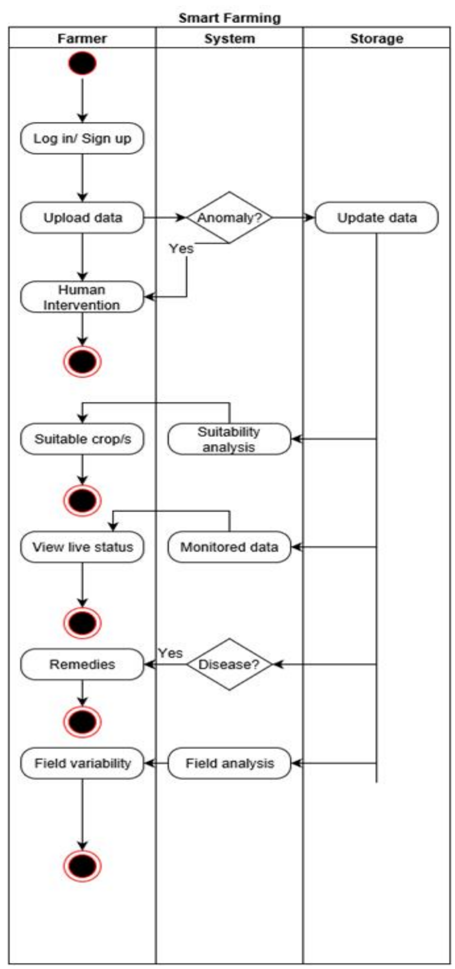

Figure 1: Activity Diagram

This figure illustrates the activity diagram of the system.

The user logs in using their credentials. Here, they can access various features such as updates on new crops or news or any type of alert. The farm data is collected by the Raspberry Pi simultaneously and continuously. This data is sent to Cloud services such as Amazon Web Services. In case of an anomaly in the data such as the soil being too dry or waterlogging, the user is alerted via a text message. Thus, the user can take necessary action based on the alert. The user can view the live status of the farm, which is the data being collected by the sensors on the web app. The information is also displayed using a live graph, which is updated continuously. The disease prediction module runs on the Raspberry Pi. The user gets an alert as soon as the Machine Learning model predicts diseases based on which an action can be taken pre-emptively. The crop suitability module predicts the crops, which are suitable to grow based on the parameters given by the user. Finally, the data is being stored on the cloud which can be used for further analysis.

IV. IMPLEMENTATION

A. Dashboard

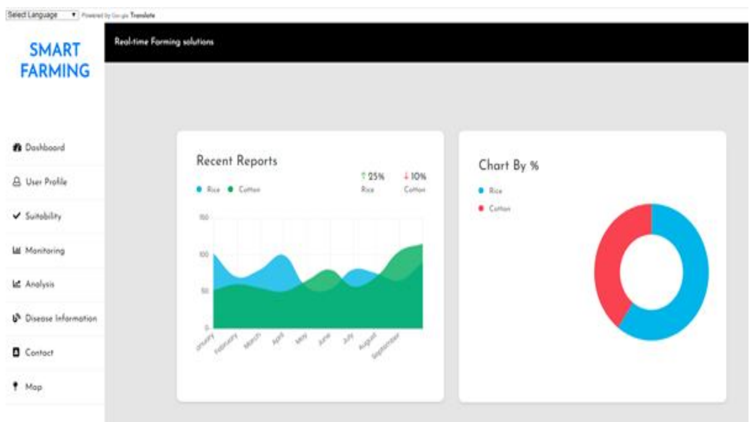

Figure 2: Dashboard

The first page in the navigation bar is the Dashboard. It presents visualized reports of the user's farm. In this case, the left side consists of the yield per month increase of the crops grown using graphs, and the right side consists of the overall crop coverage of the user.

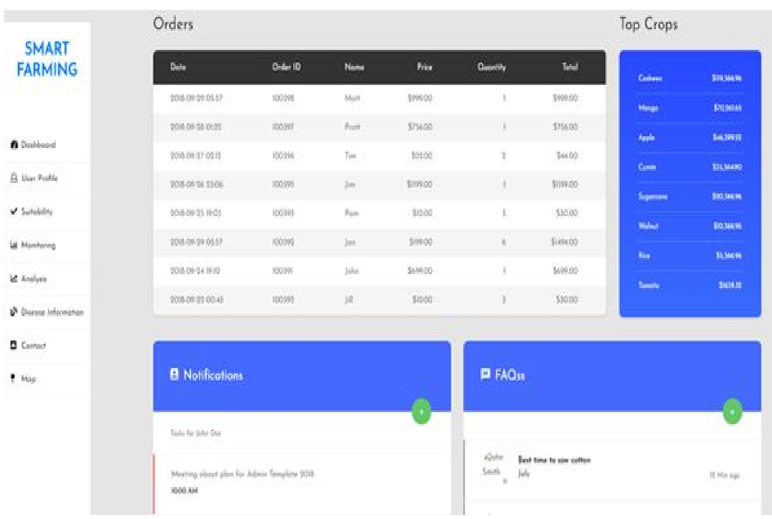

Figure 3: Dashboard

On scrolling the above page, information on past orders is given. Providing the user with information about the crops with the highest yield (top crops), general information about their farm (notification), doubts about farming (FAQs) keeps the user informed, thus the primary reason for the project to empower the user is satisfied.

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B. Suitability

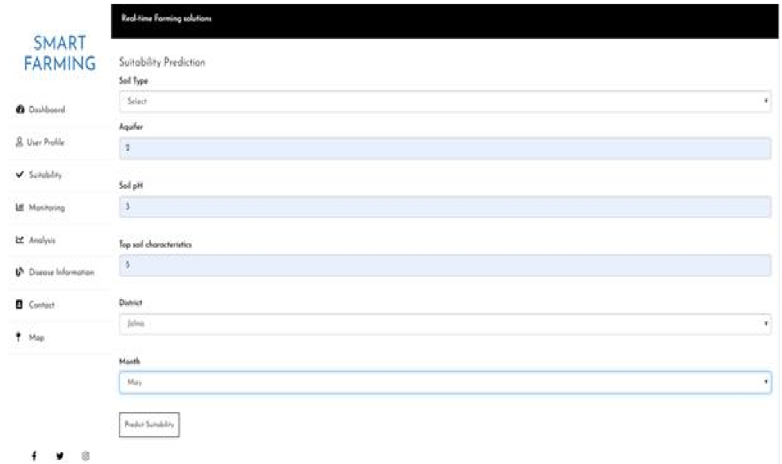

Figure 4: Inputting the required parameters for suitability

The next section in the navigation bar is Suitability Prediction. Here, the user enters the value obtained for their farm parameters.

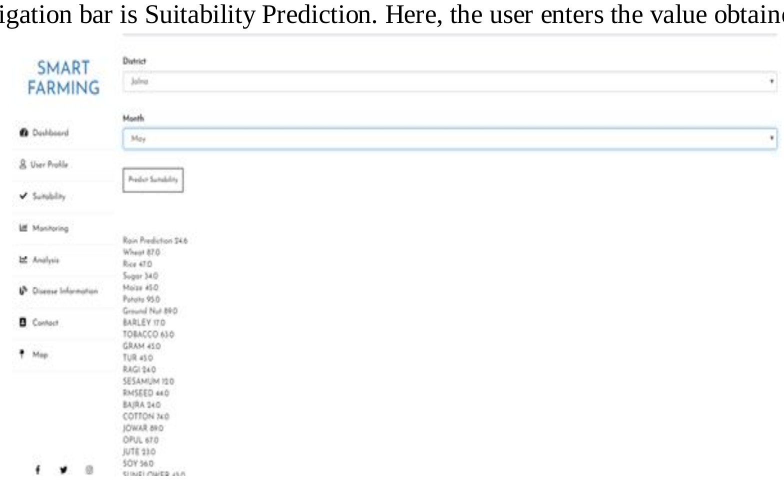

Figure 5: Suitability Prediction

On clicking the "Predict Suitability" button, the user is provided with a list of suitable crops.

C. Monitoring

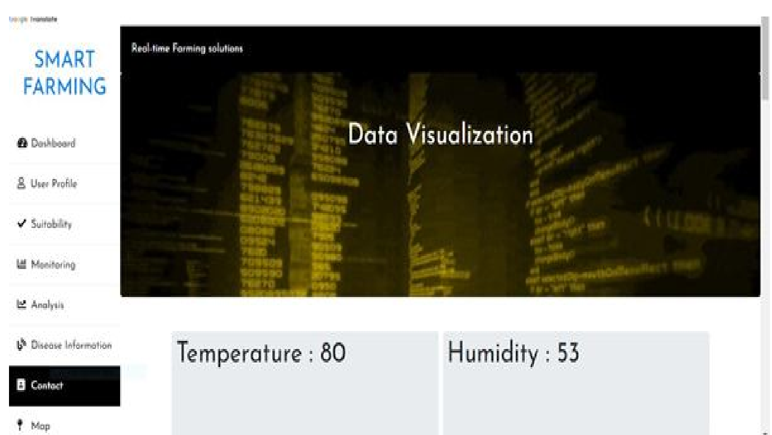

Figure 6: Visualized real-time sensor data

The real-time sensor data pushed from the sensors is visualized using graphs in this section.

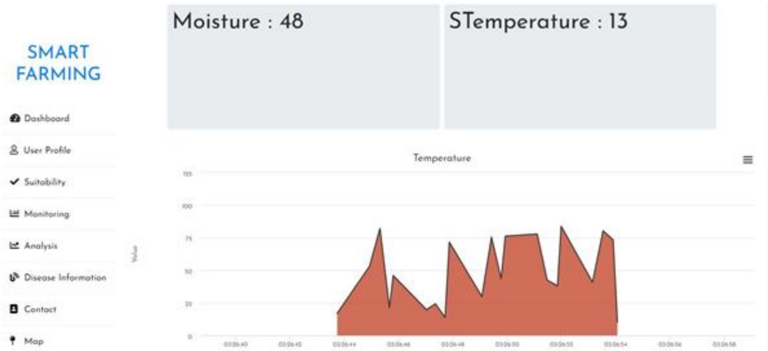

Figure 7: Visualized real-time sensor data

Here, the temperature data is shown graphically. The above graphs can be downloaded in Image format (PNG), document format (PDF), etc using the button on the top-left (3- horizontal lines stacked over one another). Similarly, humidity, moisture and soil temperature data are demonstrated.

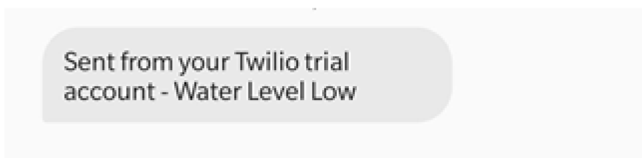

Figure 8: Notification to the user in case of an anomaly

Here, the user is notified of an anomaly detected in the data using which the farmer can take necessary action to mitigate the effects of it.

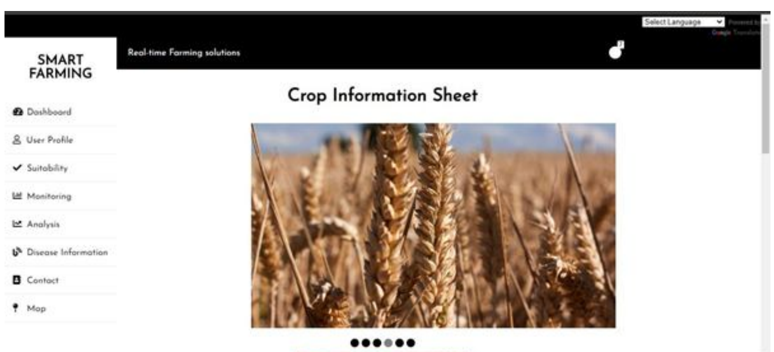

Figure 9: Crop Information Sheet

This section is the Crop Information Sheet.

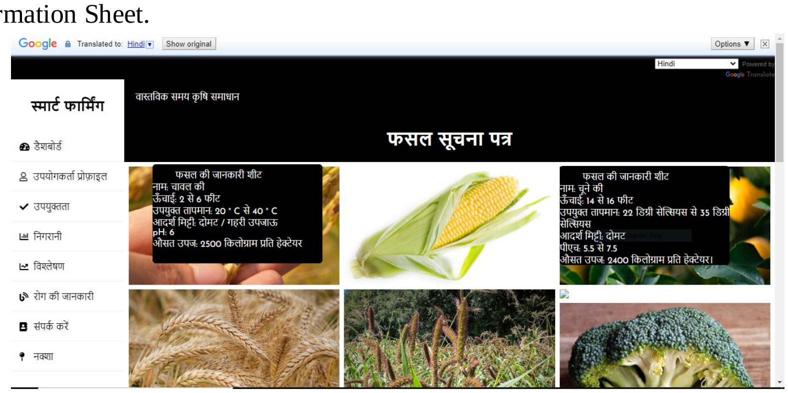

Figure 10: Crop Information Sheet

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In this section, images of different crops are used and clicking on the image of the crop provides the user with crop information of that particular crop.

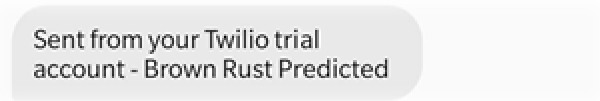


Figure 11: Message received for disease prediction

Here, the user is notified of the disease prediction using the contact point provided.

Figure 12: Disease Information Page

Figure 13: Disease Information Page

Figure 14: Disease Information Page

This section is the Disease Information Page. After the disease prediction, the user can check the information about the particular disease. We provide information about the disease, the symptoms of the disease, ways to mitigate the disease’s effects.

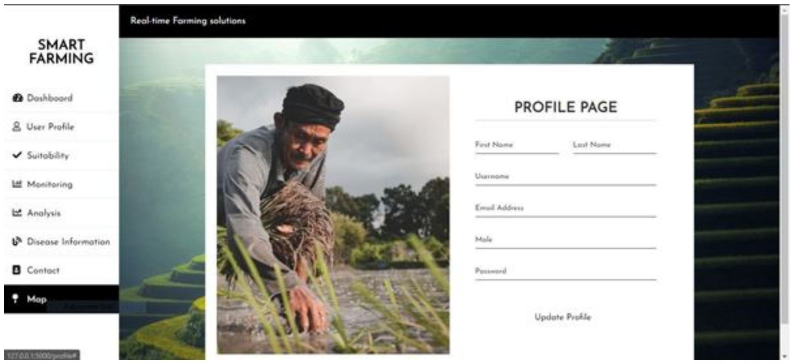


Figure 15: Profile Page

This is the profile section. Here, the user information given during registration is presented.

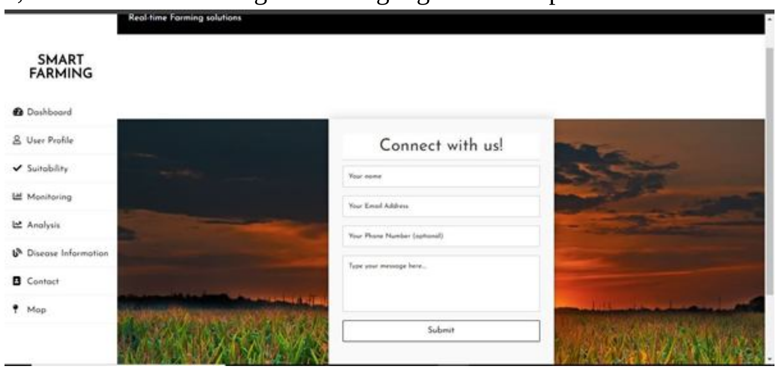
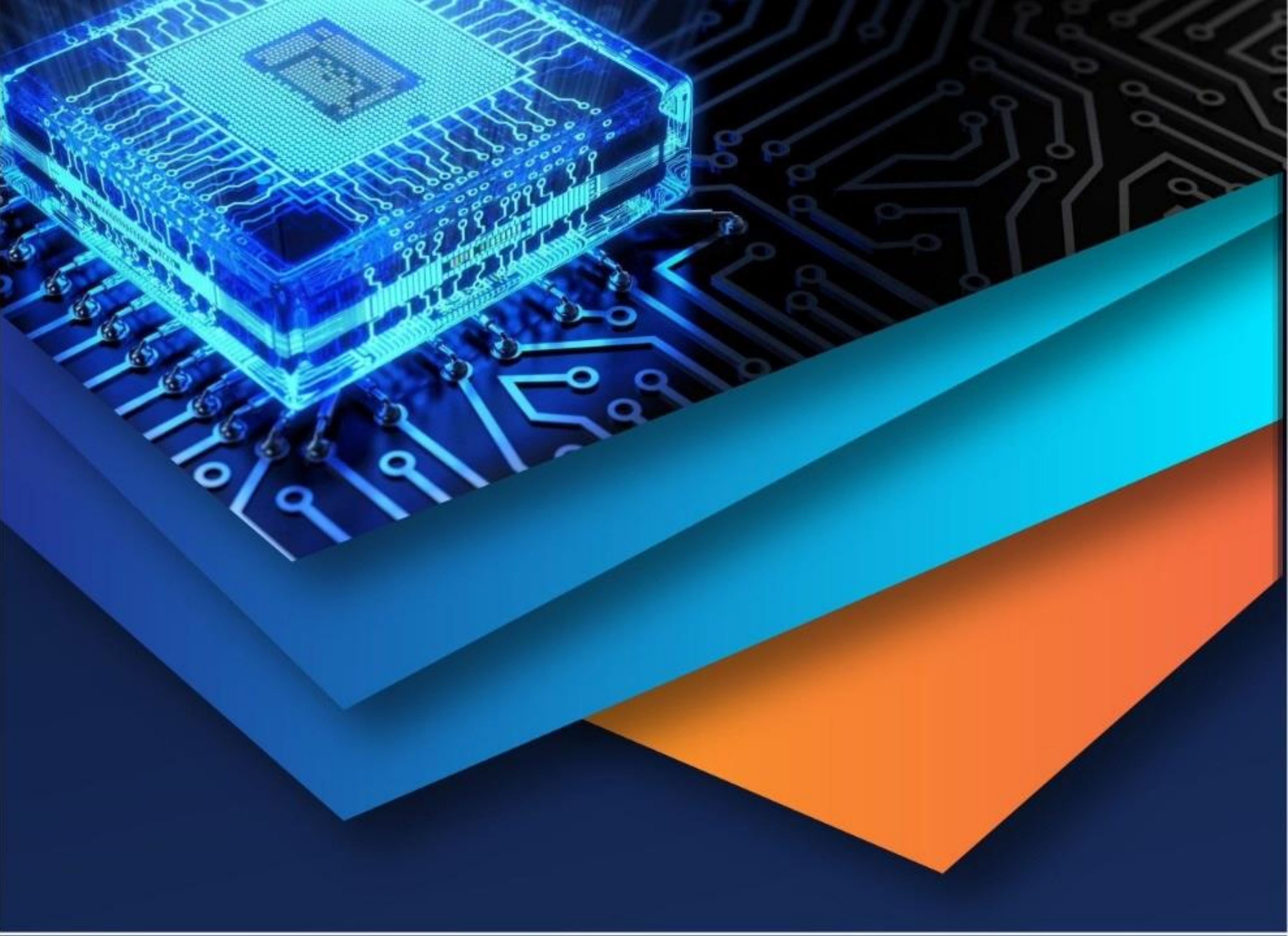


Figure 16: Contact page

The user can connect to us using this module.

REFERENCES

[1] Nihar Sardal, Ankit Patel, Vinaya Sawant, "Smart Farming", *Springer's International Conference on Recent Trends in Machine Learning, IoT, Smart Cities and Applications (ICMISC)* - This paper has been presented at the conference and will be published within 12-18 months after the conference
[2] https://www.ibef.org/industry/agriculture-india.aspx
[3] https://timesofindia.indiatimes.com/business/india-business/agricultural-wastage-is-indias-problem-no-1-here-is-why/articleshow/70974705.cms
[4] http://soilhealth.dac.gov.in/
[5] http://flybirdinnovations.com/
[6] https://www.zaubacorp.com/company/VDRONE-AGRO-PRIVATE-LIMITED/U74999KA2017PTC099217



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