

# Enhanced Economical Farming through Smart Agriculture

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## I. INTRODUCTION

Nowadays mostly the people around the world depend upon the agriculture, so do you know about the percentage dependence of agriculture in India? , As the world is competing in the field of agriculture, In India 70 percentage of its rural people depend upon the crops from the farms [1]. Hence this shows that it's an important field and it needs to be focused on the side of development. Surely in every country's Government and people think about the way they can benefit from their land and to be a leading productive country to other world countries in terms of exporting their resources or innovating a new idea [2].

As a source of food the field of agriculture has been developed everyday but it seems there are some points which are not sufficiently acquiring the needs of the people, Despite of the natural disasters such as floods, the increase of population effects the market of the crops because sometimes the supply and the demand are not balanced, may be the supply becomes high and the demand becomes low or vice versa, in addition to that there is no indication of technology that points out which crops can grow the coming season or which crops are in demand of the market, people follow the traditional measurements or predictions based on weather [3].

Nowadays technology is playing an important role to overcome the weakest points of agriculture, as a result the traditional predictions are replaced by technological predictions and measurements which are mainly driven by Artificial intelligence (AI) and Machine Learning (ML) as well as IOT, Moreover the sensors include the best electronic equipment which will make the measurements more accurate [ 4].

This work makes use of Machine learning to predict the future crop prices on the market making sure the farmer makes educated decisions on what crop will give him the highest return on the piece of their land. This is achieved by linking the application to the live crop feed and analysing previous data and mapping out future prices through Machine learning algorithms, also the ability of smart monitoring of the farm environment allows the farmer not to be present full-time at the farm since low-scale farmer typically work numerous jobs to sustain their families [5].

With the use of IoT based sensors vital information can be relayed in real-time to the farmer so that the necessary action can be taken on priority [6]. Smart monitoring of the soil/climatic conditions enable the farming to plant a crop

that will grow well in those conditions making sure the farmer gets the best from the available piece of land. This is achieved by the various sensors communicating with the farmer through the mobile application platform [7].

To implement this work does not need only software but also hardware, so imagine what type of electronic devices could be used. Although this will be explained in the next section in detail but the sensors are playing a major role here and the different sensors used in this work are soil moisture, temperature, humidity module and PH sensors. Hence the data will be collected in real time from these sensors and further processed & used to get the perfect choice of the different soil characteristics and other contents with the help of different algorithms of the AI and ML, in addition to that the processor board is used to benefit from its built in capabilities for the purpose of interfacing of hardware [8].

From the above paragraph context there are three main strategies that should be followed during the work which are shown in figure 1 [9]:

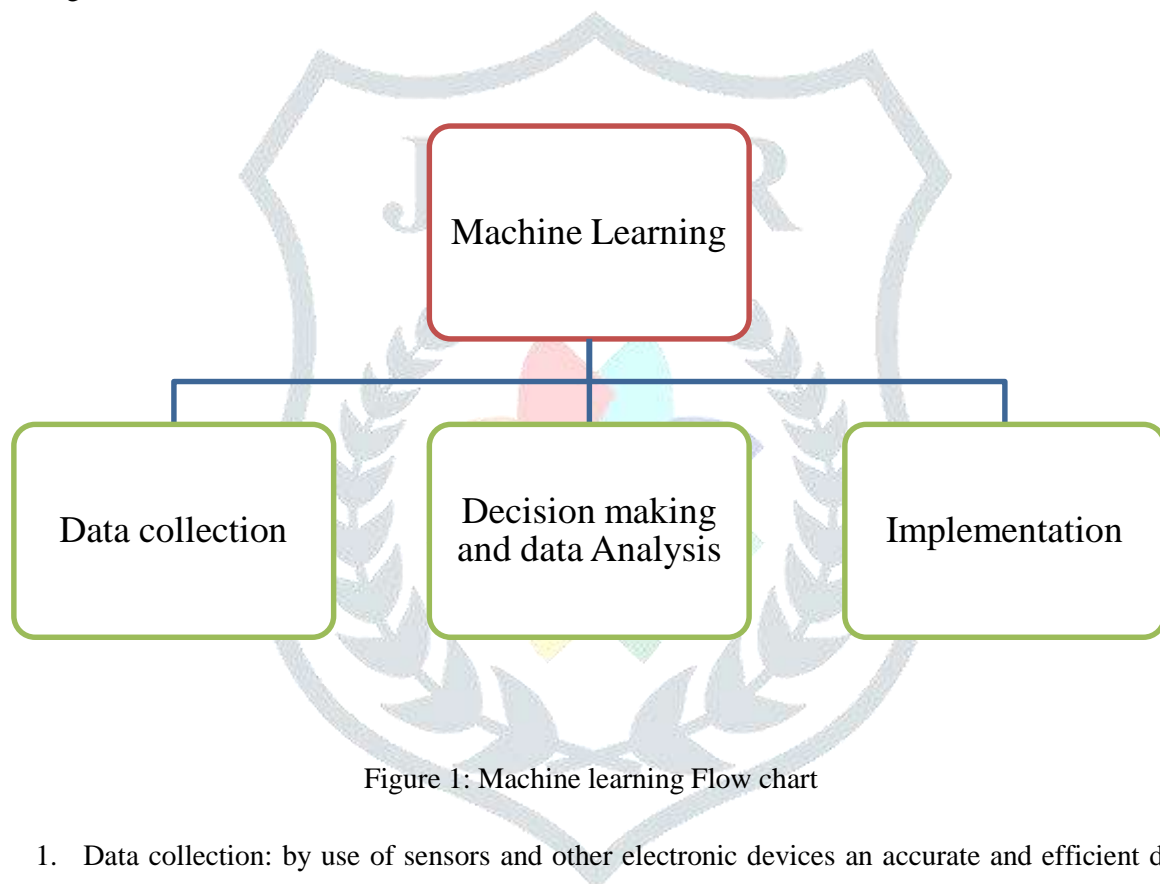


Figure 1: Machine learning Flow chart

1. Data collection: by use of sensors and other electronic devices an accurate and efficient data will be collected.
2. Decision making and information analysis: here by the use of the different algorithms the best suitable decision will be taken according to the data.
3. Implementation: finally the decision has to be implemented in order to reach the desired goals

More importantly taking the exact measurements and accurate data determination is required that's the first step should be carefully focused and checked well.

Finally this work is about the way of reaching high satisfaction point in terms of today's available resources which are the internet technology and the modern electronic devices, which means implementing them together in order to solve an early existing problem, as a result in the farming sector this effort will be a problem solving innovation to the society. See Figure 2 which is showing the smart farming in agriculture.



Figure 2: A picture showing smart Farming in Agriculture

## II. LITERATURE REVIEW

Although there are a lot of work that has been done to develop the agricultural field using parameters such as weather forecasting, soil nutrients, NPK (Nitrogen, phosphorous, potassium), so with the help of these mentioned parameters and more some different algorithms of machine learning and artificial intelligence are being applied yet there are some points which are still lagging. Also the nowadays supply and demand of the market is not balanced that's why the farmers face a huge difficulties and sometimes lose instead of the predicted profit.

Hence to develop and create a well-deserved output farmers should be provided with the proper technology in order to gain more profits. A website containing information related to market rates, seasonal crops etc. would really help them to get more returns. It also helps to boost the economy as well. Providing the small scale farmers with proper agricultural related information will lead to sustainability as well as for economic development.

Every farmer has got a mobile phone these days. So a friendly website could help them to have better understanding of the crops, soil state and markets as well. It will help them to come up over many troubles that they are facing nowadays [10].

The major challenge in designing a farming system is that it should be understandable to farmers and he must be able to adopt it without much difficulty. The potential outcomes that we should look for are, (a) the techniques should be simple and easy to implement, (b) the effective cost should be less, (c) the probability of prediction should be high, (d) the system must provide higher returns than those available already, (e) it should be economically feasible.

## III. HARDWARE COMPONENTS

For every problem solving situation of innovation or idea that society requires it has to be done practically, from the human mind to the technology all the components should be connected and prepared well in order to work as predicted.

Clear description of the proposed solution

Enhanced Economical Farming through Smart Agriculture is an **IoT** based device that monitors, relays data and predicts future events. It incorporates **IoT**, **Machine learning** and **Artificial Intelligence** to bring out the maximum amount of crop production on a field [11].

1. Arduino mega Wi-Fi enabled board
2. Temperature and Humidity sensor (DHT11)
3. Soil moisture sensor module soil hydrometer humidity detector
4. LDR light sensor module
5. Analog PH sensor Kit for arduino
6. Bread board
7. Jumper cables
8. Soil NPK sensor agricultural tester
9. MAX485 TTL to RS485 converter module

#### a) Arduino mega Wi-Fi enabled board

- Has the capabilities built into it to be able to interface with the internet.
- Is a more capable board than Arduino Uno in processing and computational power



Figure 3: Arduino mega Wi-Fi enabled board

#### b) Temperature and Humidity sensor (DHT11):

- DHT11 is a temperature and humidity sensor which generates a digital output and its shown in Figure 4.
- The DHT11 can be interfaced with the arduino mega WI-FI enabled board and get the desired output.
- This component is a cheap temperature and humidity sensor which is reliable and can exist for long term duration.



Figure 4: Temperature and humidity sensor (DHT11)

### c) Applications of Soil moisture sensor module soil hydrometer humidity detector:

The uses of this component are:

- Agriculture
- Gardening
- Landscape irrigation

Below is the soil moisture sensor, see Figure 5.

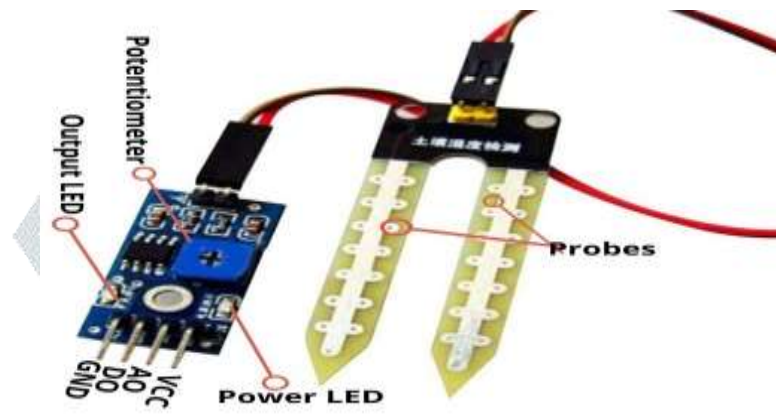


Figure 5: Soil moisture sensor module soil hydrometer humidity detector

### d) LDR light sensor module:

- As shown in Figure 6 the LDR is used for the light detection.
- The results of this module depends upon light as its output goes high for the presence of light and goes for the absence of light.
- Furthermore the sensitivity of the is adjustable with the help of potentiometer



Figure 6: Light sensor module

### e) Analog PH sensor Kit for arduino:

- The PH sensor kit has inbuilt features and it's specifically designed for arduino, the below figure 7 shows the PH sensor.

- It has LED which works as power indicator, a BNC connector and lastly PH2.0 for arduino interfacing



Figure 7: PH sensor

**f) Bread board:**

- The bread board is a component which is used as a connector, it connects the arduino and also other devices to each other by the use of jumper wires.

**g) Jumper cables:**

- The jumper cables are mainly used for circuit connections and can be classified as male and female jumper wires.

**h) Soil NPK sensor agricultural tester:**

- The soil NPK sensor tests and measures the soil nutrient contents such as soil content N(nitrogen), P (phosphorous) and K (potassium), the figure 8 shows the soil NPK sensor.
- It is necessary to know how much more contents to be added to the soil [12].



Figure 8: Soil NPK sensor

### i) MAX485 TTL to RS485 converter module

- It is an industry standard protocol for information transfer and brings numerous advantages such as converting the TTL signal to RS485 for long range, high data rate communications.
- In digital communications this converter lets you send and receive information using the RS485 network from your arduino, The below Figure 9 shows MAX485 TTL to RS485 converter.



Figure 9: MAX485 TTL to RS485 converter

## IV. METHODOLOGY

### THE MACHINE LEARNING

Nowadays the world countries are competing to make everything computer based, the different algorithms are applied to concerned area so that a verified result is reached, hence the present approaches are not satisfying yet the requirements of their societies. According to the agricultural field many approaches related to algorithms of machine learning are present hence not fulfilled the desired goals [13].

To be specific in one area and to fulfill the approaches proposed is important as well as the choice of the special algorithms to apply any work being the reason of making a beneficial, cost friendly and long lasting innovation, moreover to add value to an idea it needs special algorithms to become logically controlled and developed [14].

#### Decision Tree Algorithm

The decision tree is the mostly used supervised learning methods. Tree based algorithms mostly give accurate results while working predictive models, for any kind of problem they are acceptable to solve it [15]. Different samples of crops or soils are tested by this decision tree algorithm hence it gives accurate output whether their condition is bad or good. So if it gives the condition of the crop or soil as bad then the farmer will avoid that crop. In terms of soil and crop the different parameters of checking are PH , Humidity, Temperature and NPK.

## V. RESULT AND DISCUSSION

A collected data of different crops is being tested using decision tree algorithm and the parameters are samples, value and class , so a collected sample of data has a value and the values can be classified as in terms of condition ( good and bad ), 20 percentage( size=0.2) of the data has been tested. A figure showing samples of data is mentioned below.

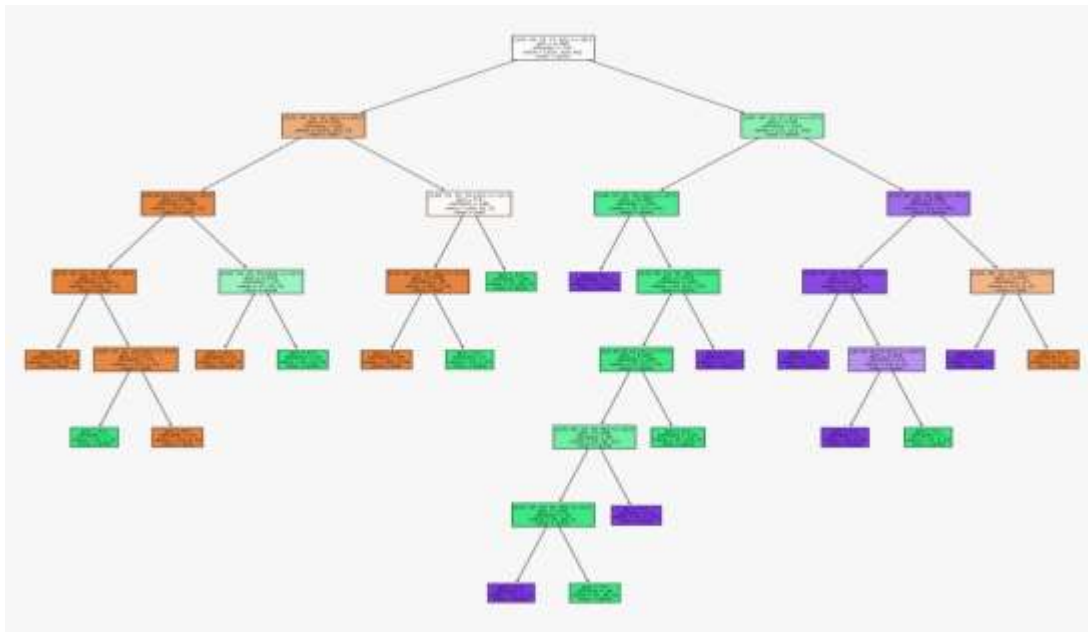


Figure 10: Decision tree diagram showing different samples of data

The soil can be classified using different parameters such as PH value, rainfall, humidity, temperature and NPK. So the conditions are very good, good, bad and very bad. Table 1, Table 2 , Table 3 and Table 4 are showing some different samples of data which are having some different conditions in terms of the parameters as shown below.

Table 1: checking the different conditions of the soil

Serial no.	PH	Rainfall	Humidity	Temperature	potassium	nitrogen	phosphorous	Condition
0	6	50	50	20	45	75	45	Very bad
1	6	50	50	20	40	70	40	Bad
2	6	50	50	20	35	65	35	Medium
3	6	50	50	20	30	60	30	Very good
4	6	50	50	20	25	55	25	Good

Table 2: checking the condition of the soil with the help of different parameters

Sample	PH	rainfall	humidity	Temperature	potassium	nitrogen	phosphorous	Condition
47	6	55	50	20	35	65	35	Medium
218	6	70	60	25	25	55	25	Good
111	6	60	55	25	45	75	45	Very bad
235	6	75	55	20	45	75	45	Very bad
358	7	60	50	20	25	55	25	Good



Table 3: checking the wheat crop condition

Serial no.	PH	rainfall	humidity	temperature	Potassium	Nitrogen	phosphorous	crop	Condition
0	4	30	32	40	24	46	21	wheat	Bad
1	4	30	33	43	21	47	22	Wheat	Bad
2	4	30	33	45	19	47	20	Wheat	Bad
3	4	30	34	43	19	48	20	Wheat	Bad
4	4	30	34	45	24	50	19	wheat	Bad

Table 4: comparing the conditions of two crops ( paddy and wheat)

sample	PH	Rainfall	humidity	temperature	potassium	nitrogen	phosphorous	Crop	condition
408	4	145	60	22	35	99	30	Paddy	Good
342	4	142	49	22	28	92	27	paddy	Bad
53	4	37	33	45	22	46	20	Wheat	Bad
55	4	37	35	45	24	49	18	Wheat	Bad
499	4	168	54	22	35	115	37	paddy	Good

See the below flow chart which is showing ranges( count) and the conditions of the soil for some samples of data.

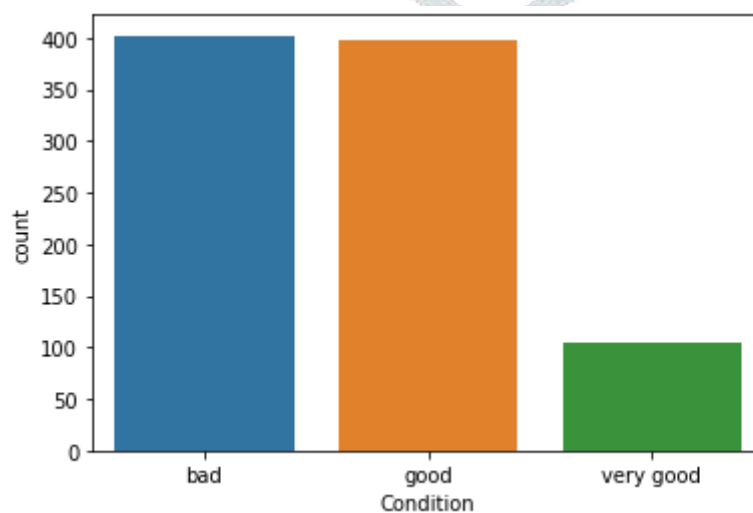


Figure 11: Flow chart of samples of data

Below is the simulation of the work using proteus software. Figure 12 shows the virtual implementation of the different hardware components mentioned in section (III).

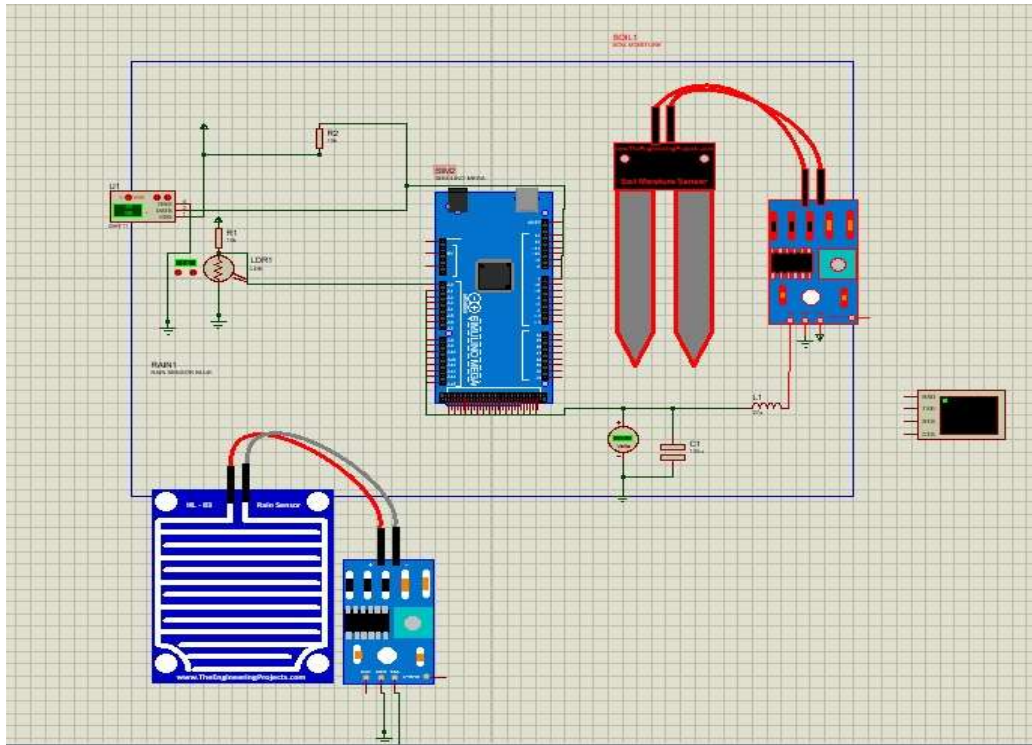


Figure 12: Simulation of the hardware components using proteus software

## VI. CONCLUSION

The farmers are the most hardworking people with less reward. They should be helped with providing insights on farming techniques, which help them to work smarter and to get more returns. In this work our main aim was monitoring the farm, that it should help farmers to develop smart working techniques. This prototype would help farmer to test the nature of soil and suggest in what to cultivate in his farm and to avoid if the test fails. Also while farmer is taking a decision the market should be a priority, Farmers could even monitor their fields wherever they are like at comfort of their homes.

## References:

1. Bisht, Ishwari Singh, Jai Chand Rana, and Sudhir Pal Ahlawat. "The Future of Smallholder Farming in India: Some Sustainability Considerations." *Sustainability* 12.9 (2020): 3751
2. Lizio, Warren, and Daniel A. Lass. "CSA 2001: An evolving platform for ecological and economical agricultural marketing and production." *Department of Resource Economics, University of Massachusetts* (2005).
3. Sivakumar, Mannava VK, and Raymond P. Motha, eds. *Managing weather and climate risks in agriculture*. Springer Science & Business Media, 2008.
4. Jagannathan, S., and R. Priyatharshini. "Smart farming system using sensors for agricultural task automation." *2015 IEEE Technological Innovation in ICT for Agriculture and Rural Development (TIAR)*. IEEE, 2015.

5. Bansal, Sandeep, and G. Geetha. "A Machine Learning Approach towards Automatic Water Quality Monitoring." *Journal of Water Chemistry and Technology* 42.5 (2020): 321-328.
6. Navarro, Emerson, Nuno Costa, and António Pereira. "A systematic review of IoT solutions for smart farming." *Sensors* 20.15 (2020): 4231.
7. Ramya, R., C. Sandhya, and R. Shwetha. "Smart farming systems using sensors." *2017 IEEE Technological Innovations in ICT for Agriculture and Rural Development (TIAR)*. IEEE, 2017.
8. Ullo, Silvia Liberata, and G. R. Sinha. "Advances in smart environment monitoring systems using iot and sensors." *Sensors* 20.11 (2020): 3113.
9. Rezk, Nermeen Gamal, et al. "An efficient IoT based smart farming system using machine learning algorithms." *Multimedia Tools and Applications* 80.1 (2021): 773-797
10. Pannell, D. J. "Social and economic challenges in the development of complex farming systems." *Agroforestry Systems* 45.1 (1999): 395-411
11. Rahman, Sk Al Zaminur, Kaushik Chandra Mitra, and SM Mohidul Islam. "Soil classification using machine learning methods and crop suggestion based on soil series." *2018 21st International Conference of Computer and Information Technology (ICCIT)*. IEEE, 2018.
12. Kapse, Smita, et al. "IOT Enable Soil Testing NPK Nutrient Detection. 9." (2020).
13. Alizamir, Meysam, et al. "Advanced machine learning model for better prediction accuracy of soil temperature at different depths." *Plos one* 15.4 (2020): e0231055.
14. Sharma, Abhinav, et al. "Machine Learning Applications for Precision Agriculture: A Comprehensive Review." *IEEE Access* (2020).
15. Jahan, Nusrat, and Rezvi Shahariar. "Predicting fertilizer treatment of maize using decision tree algorithm." *Indonesian Journal of Electrical Engineering and Computer Science* 20.3 (2020): 1427-1434..