Soil Investigation and Seed Dispensing Station for Farmers using IoT

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Abstract - *Agriculture consists almost 70% of India's economy and is the most demanded job in villages. It includes growing of crops and selling them on a large scale. In this paper, an idea to improve the agricultural trends and practices with the help of digitalization and automation is discussed. Food, being an important necessity for survival, is priority for all life forms on earth. This makes agriculture or food cultivation to be one of the most significant practices. Even though agriculture is the primary occupation in numerous countries, there are still many areas that need enhancements in order to gain best quality and maximum productive outputs. Poor quality seeds, lack of education and knowledge amongst farmers, improper cultivation techniques, improper storage and timeline management are some of the main reasons that hamper the growth of top quality crops resulting in supply chain disruption which indirectly affects farmers as their incomes remain low. Here, we propose a multifunctional automated seed dispensing, data recording & analysis machine which can help farmers link directly with the government centers to overcome some of the issues mentioned above with the help of Internet of Things (IoT).*

Key Words: Agriculture, IoT (Internet of Things), Soil Management, Quality Seed Dispensing, RFID.

1. INTRODUCTION

Farming has always been primary occupation in many countries like India. Majority of the rural population is dependent on agriculture as its only income source. The traditional practices used by farmers are slow and unpredictable. Proper information sharing combined with right and timely execution can drastically enhance the current shortcomings in agriculture. Maximizing the profit for farmers (which in turn will improve their standard of living and also reduce suicides cases due to poverty and debt) is entirely based on a cycle of events that starts from accessibility to high quality seeds, having proper knowledge about growing conditions, soil quality management, weather compatibility, diversification and timeliness in cultivation techniques and proper utilization of land.

Efforts are being made for enhancing the quality of produce in agriculture with mechanization and technology introduction. With digitalization and automation wave taking over the world, it is yet to completely reach out to the wider masses.

1.1 Problems focused

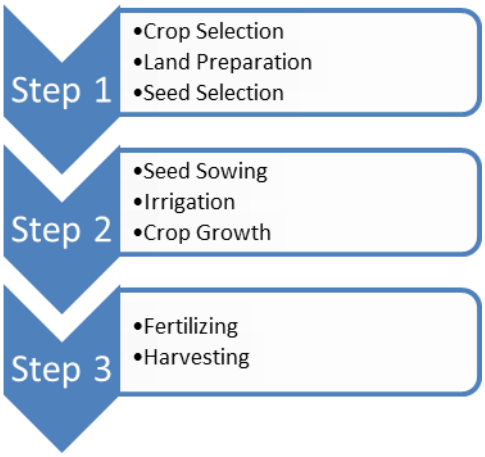

Fig -1: Problems focused

Above figure gives an overview of basic steps involved in agriculture process. Some of the problems involved in these practices are –

1) Lack of Information about –

   a) Pricing of different crops
   b) Sale Potential and Market Demand
   c) Estimated Budget for crop cultivation
   d) Suitability of crop in accordance to climate and land type
   e) Other alternatives
   f) Minimize negative impact, if any, from previous cultivation
   g) Fertilizers needed to prepare land
   h) Layout for efficient irrigation
   i) Latest techniques for enhanced productivity.
   j) Average yield of selected seed and water requirements
   k) Resistance to diseases
   l) Location of Distribution offices
   m) Optimal time, weather and depth for sowing seed
   n) Amount and Frequency of irrigation
   o) Time and Method for ploughing and weeding
   p) Expected pest and virus attacks with precautionary measures.
   q) Proper crop harvesting time and storage techniques
   r) Cost of transportation

2) Availability of poor quality seeds

3) Lack of proper seed distribution facilities

4) Unpredictability in availability of government officials in offices for consultations

5) Cost and time consumption for farmers to travel long distances to reach research labs or information centers.

6) Due to improper pH many important soil nutrients dissolve in the soil and hence plants are affected by deficiency of important nutrients.

2. PROPOSED SOLUTION

Fig -2: Prototype

The idea proposed is an internet enabled self-service "SEEDBOX", an independent and automatic seed dispensing station. The station would serve as a one stop solution for all queries and requirements of a farmer in a particular area. It would provide all necessary information about the seeds selected, information on better production techniques and market updates helpful for farmers. Farming as well as "precision farming" is important. Apart from an interactive Graphical User Interface (GUI) displaying information, the system offers collection of high quality seeds for cultivation and also has attachments for measuring the fertility of the soil. A farmer can bring the sample of the soil at the dispensing station and check the soil quality with the help of pH sensor. The tester indicates the pH and gives solution for farming according to the pH of the soil. Addressing some of the previously mentioned problems, the SEEDBOX is a complete machine with Graphical User Interface (GUI) and embedded system focusing on five basic services required for farmers –

1) Identification and accessibility of data to farmer as well as government
2) Latest updates on all farm related information
3) Posting direct queries to the authorities
4) Withdrawal of required high yielding seeds
5) Measuring the quality of the soil and the amount of nutrients in it

2.1 Methodology

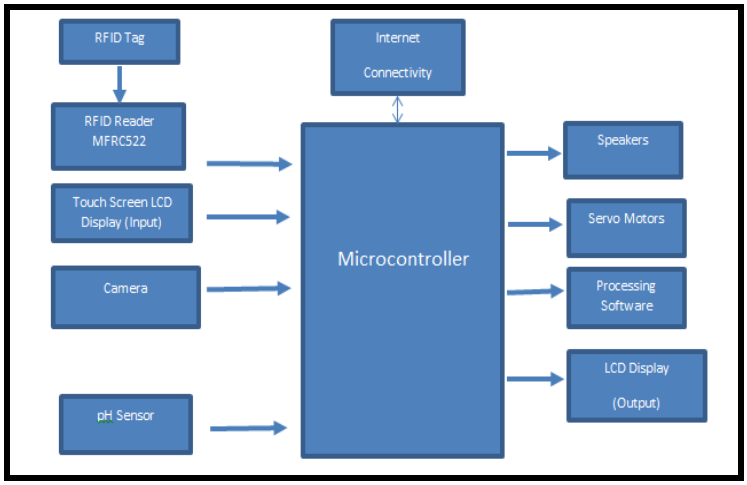

Fig -3: BLOCK DIAGRAM

The system consists of a Graphic User Interface (GUI), an RFID reader, Touch based user input, Camera, Servo Motors, and a microcontroller controlling the audio system in their regional languages for better understanding.

The components/technologies used are:

Microcontroller – A microcontroller consists of the main processing and controlling unit of the system. All the input and output devices used in the system are interfaced to the Input / Output (I/O) pins of the microcontroller and the program for execution is stored in the memory of the microcontroller. The microcontroller used in the project is ATMEL ATMEGA256. The controller has upto 256 Kb of memory to store instructions, 8 bit processing unit and more than 50 interfacing pins for external modules.

Fig -4: Microcontroller

RFID – RFID stands for Radio Frequency Identification. Information in electronic form is stored in Tags/Cards. The RFID Reader continuously emits radio waves and when RFID tags/cards come in range of the reader, data is transferred from tag to reader via the electromagnetic field present. This read information is then forwarded to the controller to automatically recognize and track the tag/card. The communication between the RFID and Microcontroller is established via the Serial Peripheral Interface (SPI) protocol.

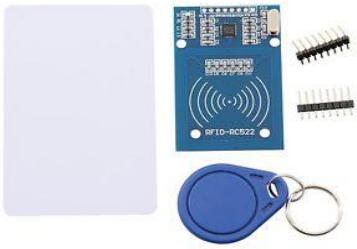

Fig -5: RFID Reader and tags

Touch Screen Display – For displaying information and interacting with the system, a capacitive touch screen display has been used. These screens are activated when touched by a human skin. When a finger touches the touchscreen, some of the electrical charge transfers from the screen to the user. Sensors in all four corners of the screen detect the decrease of electric current. The controller then determines the touch point.

Fig -6: Touch Screen Display

Servo Motors – Servo motors are electromechanical devices required for particular degree of movement in certain mechanisms. A servo motor generally consists of a DC motor for rotations and a closed feedback mechanism with a control circuit to measure the amount of degrees the shaft of the motor has rotated and hence control the angle. Multiple servo motors are placed inside the system controlling the dispensing of seeds from the internal storage mechanism.

Fig -7: Servo motor

pH Sensor – Measuring the pH is very important for plants. The pH sensor measures the changes its resistivity according to the change in pH. This value is then mapped from 0 to 14 to be converted into pH. The PCB with it is used to set the offset of the pH sensor according to the temperature of the environment or the solution to be tested.

Fig -8: pH Sensor

Following table shows pH ranges suitable for plant growth. [6]

pH<3.7	Too Acidic	No plant growth possible
3.7<pH<5	Slight Acidic	Sensitive for certain crops
5<pH<8	Towards Neutral	Ideal for growth
8<pH<9	Slight Alkaline	Some nutrients might become unavailable
pH>9	Too Alkaline	Not ideal for crop growth

Camera – Camera serves as an input device for capturing photo of the user for verification and transaction records handling purposes.

IoT– The system is connected to the internet through 802.11n Wireless LAN adapter. Internet connectivity helps in real time weather and climate updates and to understand latest news and trends activities.

3. IMPLEMENTATION AND RESULTS

The identity of each farmer is stored by linking the transactions with their bank accounts and Aadhaar Smart Card. The farmer would be identified using the RFID in his Aadhar Card using an RFID Reader. It would use a camera interface to capture images for security purposes. The farmer will be identified and all the details about the farmer will be displayed on the GUI. Then the farmer himself can choose different services like:

1. Account Details: It would display the account details of the farmer with the records of previous transactions where the farmer can also check his profits and input amount of food production so that it can directly be sold in markets.
2. Market updates: It would inform the farmer about the current demands of different seeds in national and international markets. It would show the the pricing of different crops which are to be sold in the market.
3. Weather updates: the farmer will be guided about the current weather conditions and the future

weather forecast. He would be guided about which seeds to grow in that particular weather and what sort of protection and techniques to be used.

4. Withdraw seeds: The farmer can know the details of particular type of crop. Details like how to sow the seeds, type of climate required, amount of fertilizers to be used, frequency of irrigation needed, resistence to diseases and expected yield. If the farmer is satisfied and sure about buying that type of seeds then he can select the seed and withdraw the seeds.

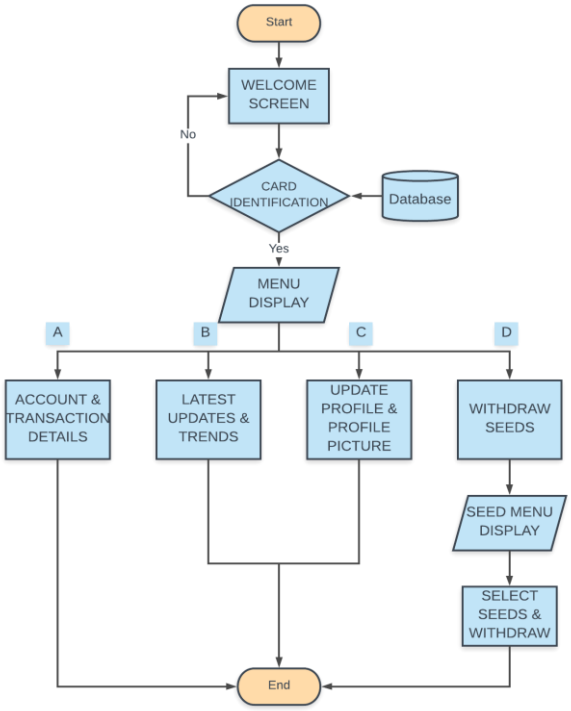

Fig -9: GUI Flowchart

Fig -10: Welcome Screen

Fig -11: Account Details

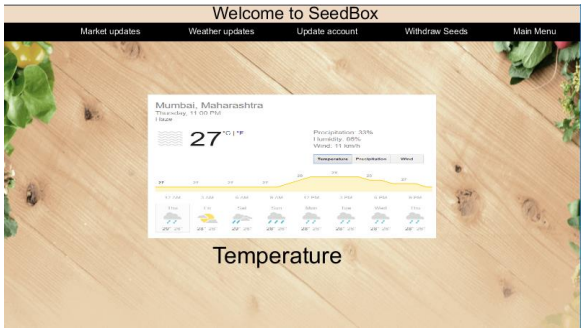

Fig -12: Weather Updates (Temperature)

Fig -13: Seed Selection

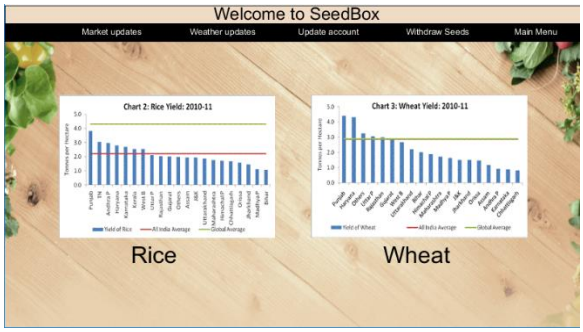

Fig -14: Market Updates

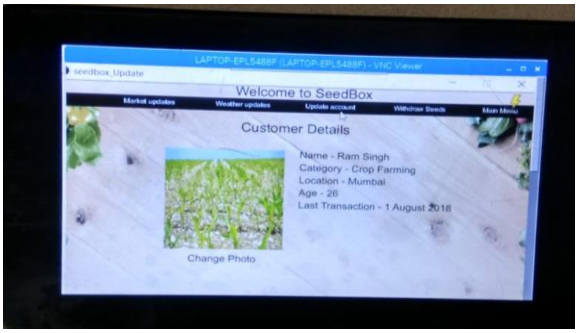

Fig -15: Output on screen

4. FUTURE ENHANCEMENTS

In future we can have expert system in the "SEEDBOX" which could guide the farmer through each and every problem and store it in the database to determine the quality of crops the farmer is able to grow in his farm and make strategies on how to improve it. It can be linked to Agribots (Agriculture robots) to check the quality of the soil, moisture level and the amount of nutrients present in it.

5. CONCLUSION

The target of the proposed engineering work is to provide farmers with all different types of seeds in all seasons with all the necessary information about the seed. For example: how to sow the seed, how much fertilizers are needed, how much water is needed, etc. It would really be helpful for farmers in rural areas to increase their crop yield and maximize the returns on their efforts.

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