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Research Paper

Supportive System for Surrogate Virtual Farming using Mobile Computing

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Abstract*—India is predominantly an agrarian economy. The agricultural industry; despite its predominance, is plagued with myriad issues leading to serious consequences. This is a pressing matter and a multitude of reasons exist for farmers' problems but the primary causes include failure of crops and extreme debt. Apart from the natural factors affecting agriculture, the main challenges faced by a farmer lie in the financial and marketing aspects. The project aims to develop an application that would serve as a support system that would overcome the above problems. The system proposes that the farmers' lease their land to a client for a certain period of time. During this period, the farmer lets the client take on all the monetary necessities associated with the land. The condition is that the land can only be utilized for harvesting crops and maintenance activities but no other responsibilities like marketing, financing, crop failures, etc. This enables the client to implement his learning and knowledge on agriculture in a real-world, marketing of the yield real-time setup. The farmer is guaranteed a minimum return upon acceptance of the contract and would get to learn new farming techniques from the client without any financial burden. A bidding system is in place for the clients to compete for a farm of their choice. Upon placing a bid, the farmer can view and select the client of their choice and vice versa, in order to go into a mutual agreement. In this way, the contract is established between the two parties. This would serve as an intuitive way to tackle the problem that has been deep-rooted in the farmer's minds and lead them towards the path of progress. Complete transaction model between the farmers and client can be handled using a mobile computing platform using text, image, audio and video along with advisory links for both the parties. A prototype model is created using the android platform based on the above concept to evaluate its implementation.*

Keywords*—Mobile Computing; Bidding System; Surrogate farming; Financial and Marketing aspects; Lease; Agriculture*

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I. INTRODUCTION

The biggest challenge that farmers face is crippling debt and crop failure which leads to serious consequences. The impact that farmers have not only on the economy but our lives cannot be stressed enough. Every household can function normally thanks to farmers toiling tirelessly in fields to ensure that people don't go hungry. While this forms one basis as the motivation for our application, there are more alarming statistics that need to be considered. The farmer suicide rate in India is shockingly high and needs to be addressed at the earliest. In 2018 alone, close to 11,0000 farmers committed suicide, which forms 10% of all suicides committed that year. Many reasons exist for farmer suicides but the most common ones are debt and crop failure. The main causes of farmer suicides include - bankruptcy or high debt, issues related to agriculture, family problems caused due to poverty, illness and substance abuse, loss due to external factors such as floods or drought. Our application aims to help alleviate, if not eliminate these two problems by proposing an idea for mitigating the crippling debt problem and thereby ensuring that the yield has no direct effect on the farmer. While the application helps in curbing a more serious issue by lending a helping hand to the farmer in times of need, it also provides an opportunity for an agriculture enthusiast to explore his passion. In a nutshell, the interface connects farmers with farming enthusiasts who would collaborate with their knowledge and expertise to bring out a good result. The agriculturalist leases his land for a certain period of time to a client for a fixed revenue irrespective of the outcome of the crop. The application effectively lightens the farmer's burden while not compromising on his

revenue stream. While the primary motivation in the development of the application is to prevent farmers' deaths, the secondary motivation is to provide a steady source of income to the farmer as a financial boost in times of need. A supportive system for addressing these issues is indispensable. Also, agricultural enthusiasts can get hands-on experience and bring in their ideas for the betterment of the processes involved. This helps in the research and development of this sector in the long run as well.

II. RELATED WORKS

Some of the works related to these approaches towards solving the underlying issues are mentioned below. Also, references related to topics such as mobile computing, augmented reality, android systems, their testing and security are explained in this section. In [1] Samruddhi Khandare et al. proposal focuses to solve language barrier and illiteracy among farmers and because of the poor usability of the websites which provide different agricultural information including the information of government schemes, the research is to provide the farmers with an easy to use website and mobile app for their benefit so that they can get all the information related to agricultural government schemes. Though the above solution removed the language barrier and helped the farmers in benefiting from the government schemes, the financial aspect of farming was neglected.
A smart phone app has been proposed by Rakesh et al. here [2] is an easy to use and affordable solution that suggests most

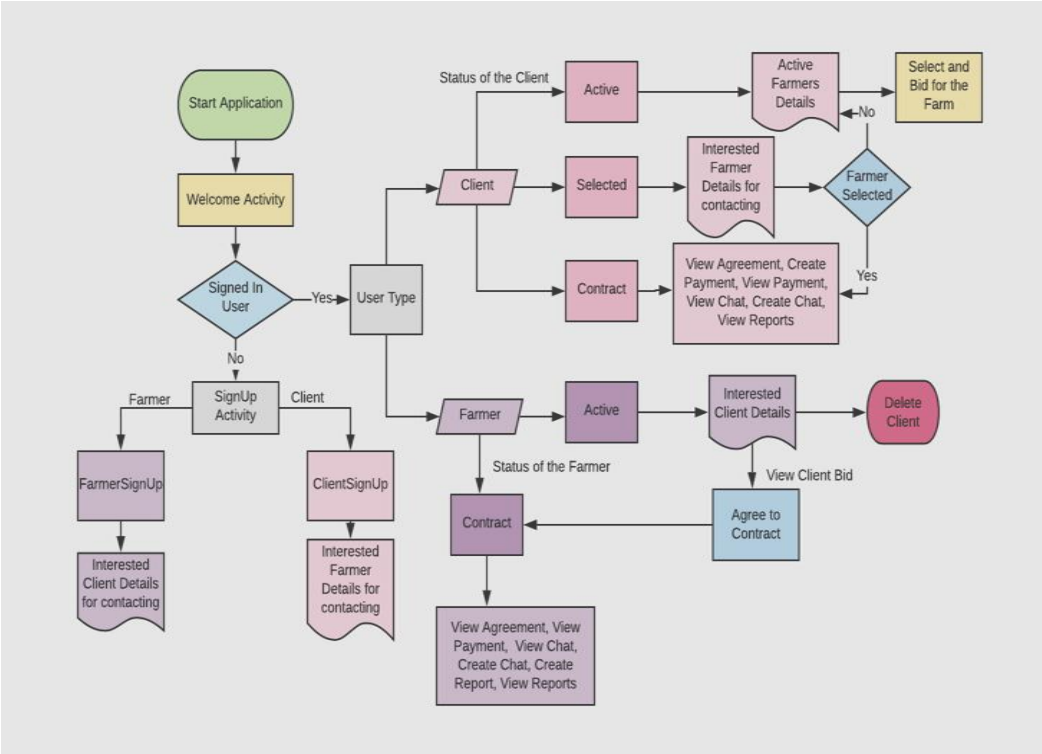

Fig.1 illustrates the architecture proposed supportive system for surrogate virtual farming

probable matching crops to people according to basic inputs like water availability in mm, average temperature, average soil ph of farm, locality of farm, soil type, crop duration, etc. so by certain calculation at backend, the app shows the most probable crops list for that farm. This solution was able to help the farmer regarding farming activities but the networking and the financial aspect of farming was neglected. In [3] Jan Bauer et al. proposed the emerging Internet of Things (IoT) and Wireless Sensor Networks (WSNs) based solution with their low-cost sensors and actors enabling novel applications and new opportunities for a more precise, site-specific, and sustainable agriculture in the context of Smart Farming. This solution was able to help farmers in various farming activities although this required installation of sensors and the financial aspect of farmers was not considered. In [4] Vijaya Kumar et al. proposed an idea to use virtual anchors across an area to aid visually challenged people to navigate within premises. In [5] M. S. Pawan Ranjith et al. provide a supportive system for low cost informatics farming to be used for better decision making by the stakeholders involved on the agricultural land using augmented satellite imagery. [6] discusses optimum point of testing, the possible outcomes of choosing a testing, and usage of technique to make the testing process cost effective. In [7] Calin Constantinov et al. discuss the types of bidding for land auction, their methods and approaches taken to build a trusted and a reputable system. In [8] Iman M. Almomani et al. explore the android permission system

evolution, the security issues and their implications. They also provide certain analysis based on application. In [9] Tim Wark et al. illustrate some of the practices that are proving detrimental to the environment and hence causing harm to agriculture. They suggest how these problems can be mitigated through computing techniques. In [10] Pranav Shriram et al talk about the problems faced by the farmers while selling their produce and propose an application to fulfill the requirements of the farmer ensuring righteous business practices. [11] Qiaobin Kuang et al. have explored the nitty-gritties of real-time status update and techniques to reduce Age of information(AoI) using mobile edge computing ensuring a zero-wait policy. [12] Maanak Gupta et al. talk about security and privacy in smart farming - present scenario, challenges and the issues faced, kind of cyber attacks and provide additional research taking place in this field. This is helpful to spread awareness of the kind of attacks and accordingly secure the smart devices to equip them to evade these attacks.

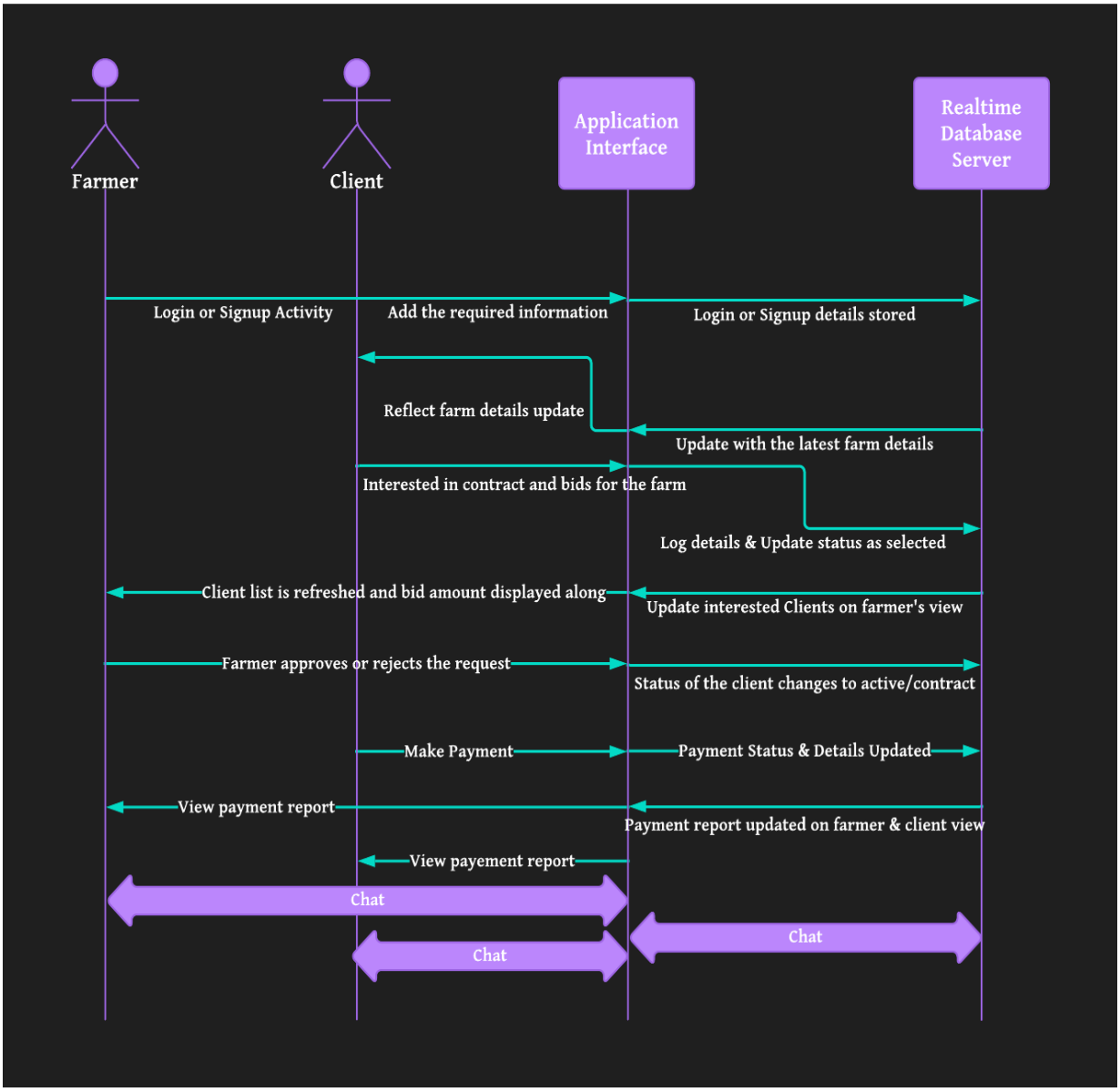

Fig. 2 Sequence of system operation

III. PROPOSED METHODOLOGY

The project aims to develop a supportive system that would serve as a handy interface for connecting the farmer and a potential client. The farmer is in a good financial state and can devote his focus on research and development of the trending agricultural practices. The client can provide knowledge sharing to the farmer on the effective farming practices and experiment them on their land. This would add to the research and development process of the agricultural practices and would pave the way for efficient farming practices. To provide hope and support for the farmer to grow and cultivate the land using modernized approaches.

The application brings together the client and farmer on a single platform where the client can contact the farmer and take the land on lease. The crops to be grown on the land depends on various factors such as fertility of soil, climatic and weather conditions. The client is provided with the list of farms with conditions suitable for specific crops to choose from. The description of the farm details along with some snapshots are available to the client to get a perspective of the land being viewed. The farmer can lease without having to worry about the financial constraint involved in farming. As, the client is responsible for the land and it can only be used for farming alone.

The application development is divided into two stages: *Pre Contract* and Post Contract phases.
These stages are explained in detail in the following paragraphs :-

1. The first part of the application system is to do with the pre contract phase, that supports sign-in or sign-up functionality. It further enables farmers to view potential clients and clients in turn to view farms. The farmer's details such as contact number and his profile information will be shared to the client. The client hence can contact the farmer using his profile if he is interested. The selection process of the farmer takes place from the client's side where he bids an amount for the selected farm. Upon an acceptance from the farmer for the bid placed, the farmer and the client come into a contract phase.

2. The second phase is the post contract phase where the interested parties can interact with each other using the application. The post contract phase involves various functionalities for the smooth communication and the transactions between the farmer and the client. The functionalities are options to create and view the chats, to create and view the payments, to create and view the reports and to view the agreement contract which gives a detailed overview of the contract agreed upon by the two parties involved.

Fig.1 depicts the processes and actions involved in the application. It gives a brief overview of the system developed.

Through the proposed system, farmers rent their land to a client. The farmer lets the client take on all the financial aspects associated with the land. The land can only be utilized for harvesting crops and no other activities. It leads to a shift from orthodox practices to an effective approach to farming. The farmer is guaranteed a fixed revenue by leasing his land and the produce has no effect on him. The client can bid for the land of his choice. Upon acceptance from the farmer, the client and the respective farmer come into a mutual contract. This would serve as an intuitive way to tackle the problem that has been deep rooted in the farmer's minds and lead them towards the path of progress.

Fig.2 represents the sequence diagram which shows various processes in the application. It depicts the login activity when we enter the application. This step is followed by requesting the details depending on the condition whether it be a farmer or client that is using it. Further, in the case of a client, he will be taken to a page with a list of farmers with their land details associated along. The client can choose a farmer based on their choice. Upon selecting the farmer, the client is provided with a bidding option. Here, they can enter in their bid against the base price that would be mentioned for each farmer. At the farmer's end, this activity of the client who is showing interest in his farm would be notified and updated requesting an approval or a denial from the farmer. This interval is depicted as agreement in fig. 1. The farmer will be presented with the list of clients who are interested in the farm along with the price that they have bid it for. Based on this decision of approval, the farmer will enter into a contract with the selected client. His status will now change to contract and is removed from the available list of farmers. After entering into the contract stage, both the parties are allowed access to chat, report and payment options.

The fact that the application adjusts according to the bid in real time enables the customers to place their bid and wait for the approval. If approved from the farmer's side the land allotted can be used by the customer for the agricultural procedures. It is pleasantly convenient to have this interface which helps keep track of all the ongoing endeavours.

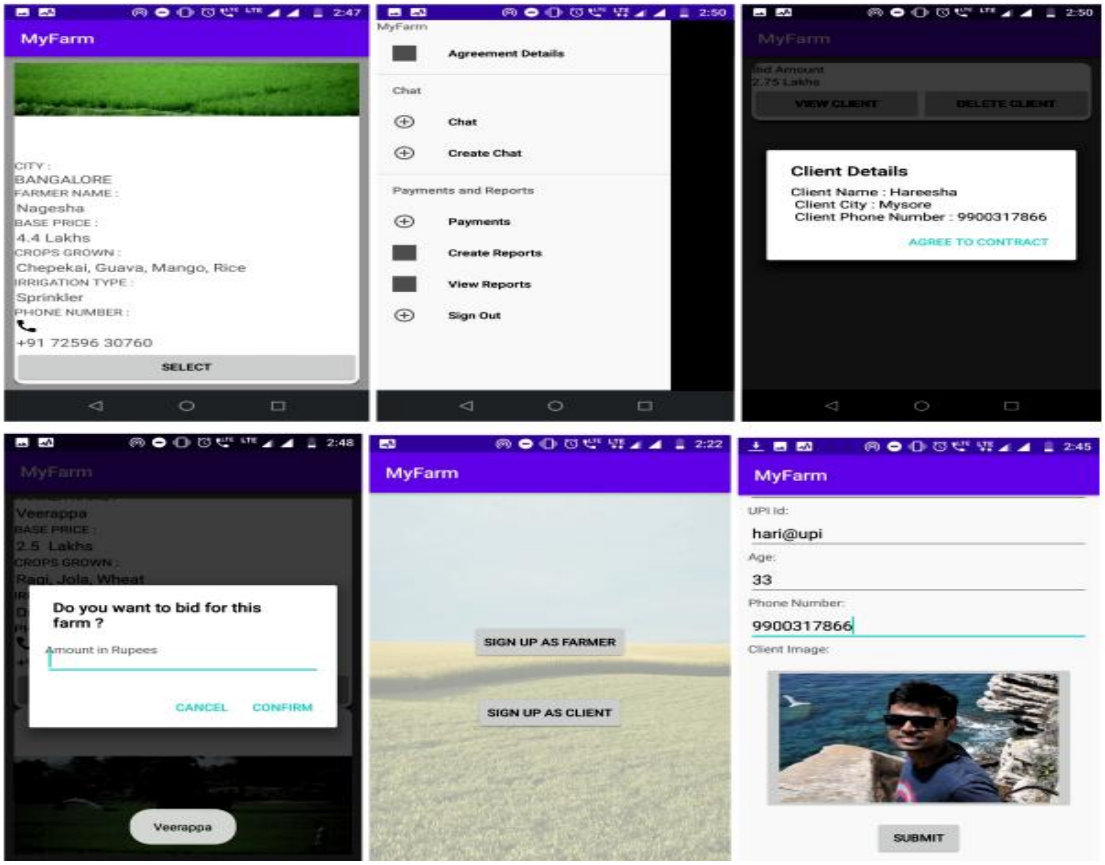

Fig. 3. Snapshots of the working prototype application

Pseudo code: Explains the working behind this application

Step1:

Sign-up and Login as farmer/client involving two-factor authentication through email and phone number to establish trust. Sign-up process is simple yet detailed and requires user input which includes both textual as well as pictorial form. This requires access to the storage for media retrieval.

Step2:

Check the ***status*** of the farmer/client based on their identity. *[Active/Selected/Contract]*

In Fig. 3, the snapshot illustrates the user interface during the various phases of the application. We see the images from the pre contract phase when the farmer and the client are requested to enter their details, farm selection process, bidding for a farm land after selection and the farmer's approval/rejection of the client willing to start a contract; and also from the post contract phase when the farmer and the client are interacting with each other. The farmer is expected to upload an image of the farm as shown in Fig.4 along with the farm details. These help the client understand the type of crops that can be grown in this region.

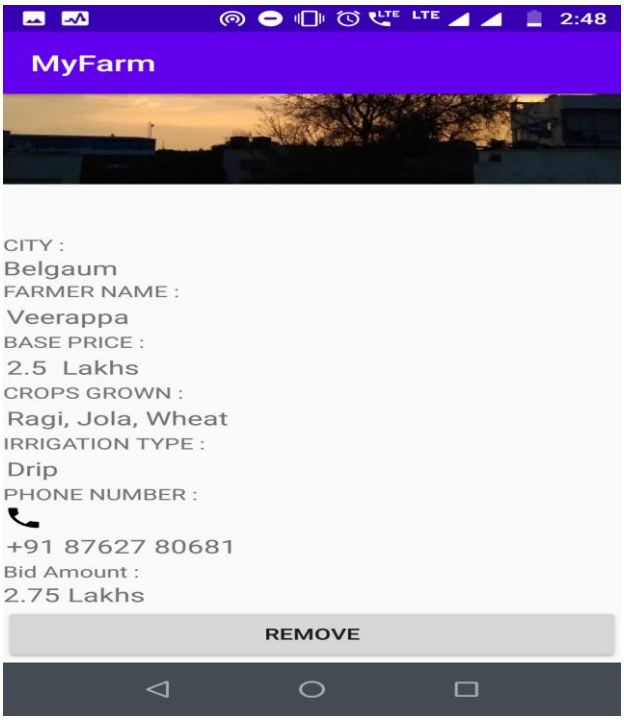

Fig. 4 Farm details along with the current bid price

Step3:
BEGIN:
a. **On the Client Side**

1. Display the list of the farmers for the client. *//* status is set to **'active'** *//*
2. Upon clicking on each farmer view, display the farmer's details along with the farm details.
3. Select a farmer to get into contract with based on the preferences. *//* status is updated to **'selected'** and wait for the acceptance or reject from the farmer *//*
4. If ***accepted***, *//* status changes to **'contract'** *//* . Features to create or view chat messages, make or view payments to the farmer, view reports updates from the farmer, along with the agreement details are made available to view.

END

b. **On the Farmer Side**
BEGIN:

1. Display the list of clients who are interested in the farmers's land. *//* status is set to **'active'** *//*
2. Upon clicking on each client in the list, display the details along with the *amount that they bid* the land for against the base price.
3. *Approve* or *Reject* the client based on the farmer's interest.
4. Once the client is ***approved***, the two parties get into a contract. *//* set the farmer status to **'contract'** *//* Features to create or view chat, view payments made by the client, create or view reports that are sent to the client, along with the agreement details are made available.

END

III. EXPERIMENTAL RESULTS

1. Emulators on the Android Studio allowed for checking the hardware compatibility of the application and the display area for the user interface.
2. The development process took care of the screen fit of the application from different media devices and works seamlessly on them.
3. Unit testing of the complete application is done to test the interaction of the activities involved within a single unit. This shows that the activities perform specific assigned tasks with loose coupling. The usage of monkey tool for stress testing is done for the developed software which runs in an adb shell directly on the device or emulator and generates pseudo-random streams of user and system events by sending commands from the API interface.

4. Requires a smartphone with 4GB+ RAM, decent internet connectivity of more than 1mbps and an Android OS with version 5.0 and above.
5. Performance testing checks the amount of main memory or secondary memory storage that the application requires and the demands that are made available by the computer system while in running state within normal limits or response time.
6. Using the profiling tools, we were able to estimate the performance for the individual function calls. These tests were performed on Android Studio conveniently. The resulting experiments showed that the features run smoothly on the interface with minimum possible resources and do satisfy all the desired criteria.

IV. CONCLUSION AND FUTURE SCOPE

The application brings together the client and farmer on a single platform where the client can contact the farmer and take the land on lease. The crops to be grown on the land depends on various factors such as fertility of soil, climatic and weather conditions.

The application development is handled throughout the process, beginning with the pre contract up until the completion that is referred to as the post contract phase. The farmer can lease without having to worry about the financial constraint involved in farming because the client would take care of and hold responsibility for the land. A fact to be noted in this proposal is that the land can only be used for farming purposes alone.

The first part is the pre contract phase that supports sign-in or sign-up functionality and it enables farmers to view potential clients and clients in turn to view farms. The second phase is the post contract phase where the interested parties can interact with each other using the application.

The farmer's details such as contact number and his profile information will be shared to the client. The client hence can contact the farmer using his profile if he is interested.

This idea can be applied into various practical situations and be extended in the field of agriculture by integrating it with features to recognise the soil contents to be fit for a particular crop. Currently an effort from the farmer is required to suggest the plausible crops that can be grown in the land. If the details of the soil is presented along, this would be helpful for the clients to choose the land based on the soil quality and contents in order for him to use it for growing a desired crop.

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