

# Kitchen Gardening App – CO4224/7224 21/22

A ubiquitous app to monitor and manage Plants

**Karthik Nallamothe, Vijayalakshmi Pillai Ganapathy Pillai, Vishrub Reddy Mettu, Vineetha Unnithan Sunitha, Hanmanth Reddy Annapureddy, Jayaprakash Neelam, Meraje Mustapha**

Department of Informatics, University of Leicester, Leicester, United Kingdom

Email: kn146@student.le.ac.uk, vpgp1@student.le.ac.uk, vrm5@student.le.ac.uk, vus1@student.le.ac.uk, hrrar2@student.le.ac.uk, jpn9@student.le.ac.uk, mm963@student.le.ac.uk

## ABSTRACT

Whilst this COVID-19 pandemic has brought unprecedented challenging effect on the lives of millions of people around the world. Brought the necessity for dependency on frequent shopping for basic needs and necessity for diverse nutrition food at reach. Valuable insights received when we discussed with users is timely watering and managing soil quality to keep the garden healthy. We went through the various processes of designing and developing an app, alongside testing for the same. We designed features that sense and assisting users in keeping track of growth, sowing, harvesting, and watering plants. User studies on “Kitchen Gardening” mobile application prototype have been conducted in two different phases, one with initial design with 6 participants and another post redesign with 6 participants. From comparing and analyzing both the feedback reports, we conclude that new design has improved overall user experience. However, we received lots of enhancement requests like weather alerts, plant encyclopedia and self-watering through IoT integration. The country-specific contribution of kitchen gardens in the economy was analyzed, and the future growth of the industry was contemplated. Kitchen Gardening app and contextual notifications based on same location or different location will help users to manage the plants and self-reliant way of growing quality veggies in urban lifestyles. This will reduce the dependencies on external vendors for essential commodities like vegetables and fruits at uncertain scenarios like pandemic lockdowns or isolation period.

## KEYWORDS

Kitchen Gardening, Ubiquitous Computing, User Studies, User Experience, Urban Lifestyle.

## INTRODUCTION

The Kitchen Gardening app is a problem solver in many ways; it can reduce the dependency on frequent purchasing and include diversity in nutrition. Malnutrition is a concern in societies hampering mental and social health, especially in young adults who are living busy urban lifestyle. Including green vegetables and herbs in the diet will balance nutrition and lead to overall healthy living. The question arises, will it be possible for people of urban lifestyle to manage and monitor gardening. Gardening is a science that requires proper guidance and alertness. Several factors play a significant role in the conditioning of plants, e.g., the moisture level of soil, sunlight, plantation season, selection of soil container, seed sowing depth, etc. The Kitchen Gardening app encompasses features and instructions pertaining to watering, seasonal sowing, harvesting, and many others. The app focuses on building a user-friendly comprehensive platform to make gardening a non-tedious and enjoyable task. The context-awareness and sensor integrations are expected to contribute significantly to kitchen gardening and expand application scalability. The connectivity and contextual notifications based on location will serve the key purpose and befitting the urban lifestyle.

## LITERATURE REVIEW

Few key literatures related to kitchen gardening highlights the need for Climate change adaption and Agricultural innovation. Prof (Dr). Jayant Shekhar, Mr. Desalegn Abebaw and Dr. Mesfin Abebe Haile [1] developed an application to increase Kitchen Garden Productivity using IOT and Virtuino app. The system will sense the moisture levels in the soil and check ambient lighting and transmit the information. Another research related by Constance Rybak, Michelle Bonatti, Hadijah Ally and Stefan Sieber [2]

highlights the major concerns about kitchen gardening in urban and rural areas have been a low appreciation, climate adversities, water management and limited knowledge.

Organic Gardening Planting Planner mobile application [3] is not only for veggies but a wide range of plants like herbs, fruits, and cover crops. This app contains information on over 5000 weather stations of North America and uses it to provide personalized suggestions of sowing time based on zip code. This app also encompasses the information about best fit soil type for different vegetables and fruit plants.

## ITERATIVE DESIGN PROCESS AND IMPLEMENTATION

The design and development of an app go through different stages; Every stage holds significant importance in adding value to the final product. The first step starts with brainstorming and ends with final app development. The various steps taken to prepare the Kitchen gardening app are explained in detail below:

### Brainstorming:

We used the online tool "MURAL" to structure and collect the ideas, then moved forward by filtering non-executable ideas and planning on the feasibility of the other ideas (Ref. Figure 1). After the prioritizing top ideas, the team continued designing workflow for those scenarios.

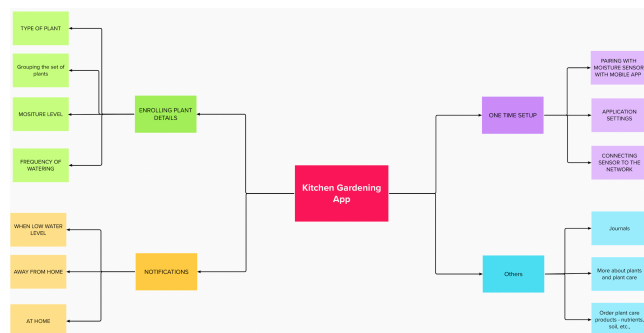


Figure 1 Brainstorming Board (MURAL)

The operations were divided into four parts sensing, connectivity, notifications, and inputting details.

**Input details:** The input details part collected all the user information like location, types of plants the user is interested in, plants planted, type of the soil, and area of the garden.

**Connectivity:** This part of the plan is to configure the app for connecting to various sensors like moisture and light

sensor. The connectivity with the network is also planned in this to ensure communication between devices.

**Notifications:** This part of the layout is crucial for the Kitchen gardening app, as it is based on notification-based services. Customizing notifications and delivering them on time is critical. The mode of notifications is also divided into subgroups like pop-ups, vibrations based, continuous or intermittent.

**Sensing:** This involves integrating the abilities to sense GPS location and customized service based on that. The app could be quipped to sense phone usage to send maintenance notifications on an activity basis.

### Sketching:

A rough pencil sketch of the app was made to picture a basic layout of the app and articulate navigation. The visually appealing design was taken forward for the next stage of designing.

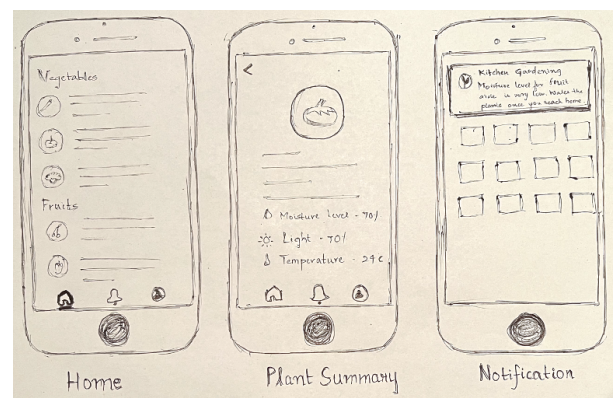


Figure 2 Sketch

Sketching gives an idea of the overall look of the app by organizing shapes and figures to make the app visually receptive and attractive; Figure 2 shows the basic design of the Homepage of the app, plant summary layout, and notification plate.

### Low fidelity prototype:

A low fidelity prototype is a digital model of the app which presents a finished form of the sketched model. We prepared a low fidelity model based on the best design available and surveyed users based on visual appeal and fonts.

The low-fidelity in-app interface of the Kitchen gardening app. The figure articulated a digital presentation of the login screen, home screen, and plant info page (Ref. Figure 3). The notification interface of the app, where the

notification tile is sized and optimized for the best visibility and usability of the user is shown in Figure 4.



Figure 3 Low-fidelity in app interface

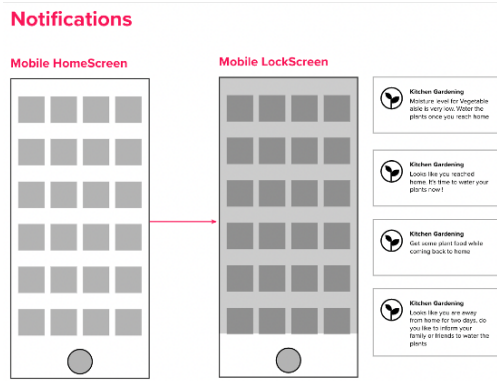


Figure 4 Low-fidelity Notification interface

## High-fidelity prototype:

A high-fidelity or hi-fi prototype is an interactive representation of the idea behind the app; this evolved form is a step higher than a low-fidelity prototype due to its close to original UI/UX and features. Based upon the feedback of the low fidelity prototype from users and testers, we figured out visual and functional modifications to be made to the hi-fi model using Figma online tool.

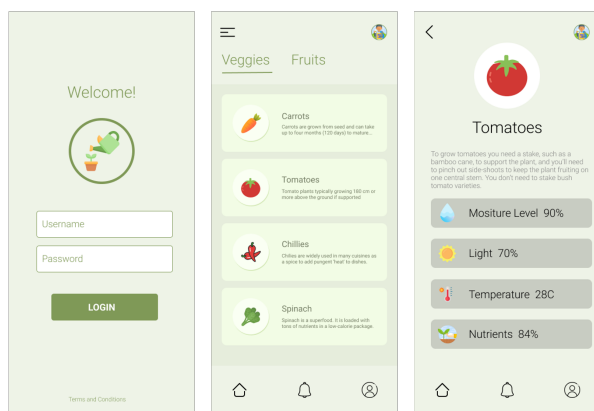


Figure 5 Final High-fidelity design based on user insights

## User studies:

Due to COVID restrictions, users requested to participate in the user study for testing the app remotely over zoom call with the consent of recording their feedback for productive developments in the app. The high-fidelity prototype was tested for its usability and aesthetics. The clickable prototype was shared over zoom, where users gave their open suggestions. The early user study before development phase and feedback collection saves a lot of development costs and time[4].

## Development:

This phase includes coding-based development of UI/UX using software platforms. We are using the Figma platform to export the design to parallel design and user interface development. This stage also includes linking the app with connectivity channels like Bluetooth and Wi-Fi and connecting with moisture sensors. The development part took care of app touch responsiveness and animations. Figure 6 shows the coding aside from the final UI. The algorithms are set crisp to function smoothly and efficiently.

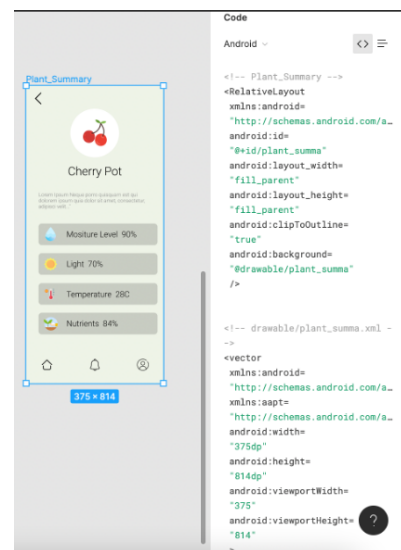


Figure 6 Front-End Development

## USER STUDIES AND PROTOTYPE

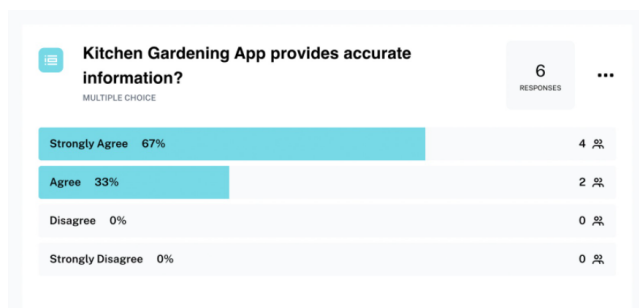
A user study was conducted in two phases; phase 1 with 6 participants where clickable prototype is shared with tasks to perform and captured qualitative insights followed with survey link designed for capture quantitative insights.

Some of the user suggestions were:

- Reduce the number of clicks.
- User required the summary of all plant sensors at one page.
- Making notifications more intuitive and context based.
- Demand on an automated report of plants every week.
- Integration of e-commerce platform for the purchase of accessories like fertilizers, pest control, seeds etc.

There are a few questions asked to users before and after the final version of the Kitchen gardening app:

Q1: Kitchen gardening app provides accurate information?



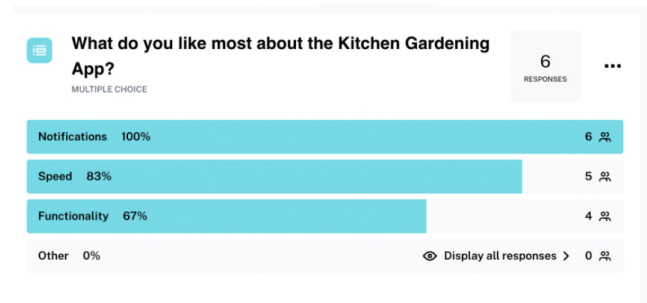
**Figure 7 Phase 2 results related to accuracy based on improved design**

While only 17 percent of users agreed to the question before presenting the final version of the app, after the final version, 67% of the users strongly agreed to the question; this shows the stringent development in the building accuracy of data provided to customers.

Q2: What do you like most about the Kitchen gardening app?

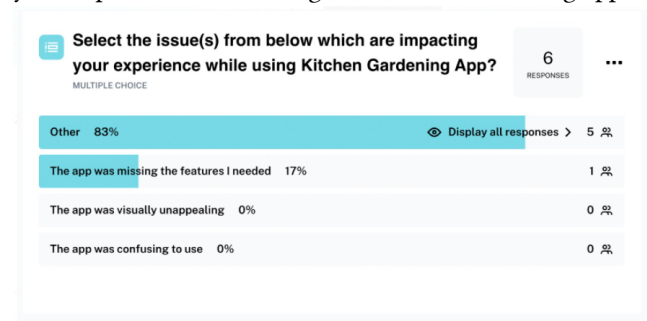
Before the rollout of the final version of the app, users voted for notifications, speed, and functionality in the proportion 67%, 17%, and 17%, respectively. The feedback collection of the same question post app development and updated designs showed results as notification speed and

functionality getting 100%, 83%, and 67%, respectively. This shows significant improvement in coding and designing of the app, the implementation of feedback also stood at great efficiency.



**Figure 8 Phase 2 survey results demonstrating increase in the percentage**

Q3: Select the issue(s) from below which are impacting your experience while using the Kitchen Gardening app?



**Figure 1 Question 3**

Before the updated app, users reported problems like; the app was visually unappealing- 50%, the app was missing the features user needed-17%, the app was confusing to use-17%. After the update, 0% of users said the app to be unappealing and confusing to use, and the parameter of missing feature stood at 17 percent. Users opted others option to signify there is no issues in the application.

## DISCUSSION

Based on survey and feature analysis, we contemplated the needs and expectations of users. Some of the critical suggestions include visual improvement, design and UI improvement, and optimization of notification frequency. The requirements of users were met where they looked satisfied with the visual and functional aspects but demanded an additional feature of future planners.

In the initial design, to view the status/condition of the plant the user have to navigate multiple times. This has been clearly reflected on the survey report to improve the application's ease of use. We iterated the design to provide the plants summary in the home page so that user doesn't have to click on each plant to view its conditions. As notifications are considered as key features, we improvised it to be more contextual to the location. E.g.: If sensors detect users have not arrived home for more than 48 hours the application will push notification to inform his friends and family to take care the plants. In future, this can be automated with the contacts added in the application settings. Based on user feedback, Aesthetics and easy navigation with large touch areas will play a good role in adaption of the application. Post redesign the application look and feel has been appreciated and more people are willing to share the application with their friends and colleagues.

The challenges faced during the integration of features were few, initial skepticism in new users regarding the accuracy of recommendations from the app. The notification timing services often did not work with 100% accuracy and sent pop-ups when the user was not in the home.

In future, application can suggest users' right nutrients and tools to buy for better price nearby based on user location. Also, application can be integrated with weather api and can suggest the garden maintenance.

## CONCLUSION AND FUTURE WORK

Kitchen gardens are the need of today. Due to the fast-moving world, the rate of urbanization is on the rise. In the wake of health consciousness, personalized nutrition is catching the attention of the civil population. The challenge in the present situation is delivering 100% accuracy; due to many technical factors, there could be a possibility of a glitch in recommendations from the app. Expanding the database by collaborating with more and more plant research organizations can improve implementation and educate users. The technical accuracy can be taken care of by regular upgradation of technology. Although gardening has become easier through the app, complete remote functionality has not yet arrived in the system, i.e., A person must be physically present to carry out gardening tasks like watering and sunlight influx.

The future of the Kitchen gardening app seems to bloom due to awareness and value addition services of the app; there could be a few ways the operation of the app may transform in the future.

IoT and cloud computing: Tasks like watering a plant are compulsive; a Kitchen gardening app can notify a user to water the plant but cannot do it by itself. The complete freedom is still not in the hands of users, where they can travel to another place and take care of their gardens remotely by managing moisture levels and sunlight. The solution lies in the integration of IoT and cloud computing in the business; the setup could contain a set of sensors like moisture sensors and water level sensors and microprocessor like arduino, which manage watering mechanism remotely through IoT and cloud computing.

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