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RESEARCH ARTICLE

Orchidopedia App –A Tool for Exploration and Collection of Orchid Species

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Identification is a major bottleneck during germplasm exploration and collection of wild species of orchids. An application named "*Orchidopedia*" is developed on the basis of database of wild orchids. This app is available offline and works independently. It has vast information for about 172 species belonging to 56 genera of wild orchid species. Orchidopedia is an android based mobile application that focuses on orchid species of the North-Eastern states of India. The app is user friendly and can be freely downloaded from Google Play Store (https://play.google.com/store/apps/details?id=nrco.orchidopedia&hl=en) and also from the website of ICAR-National Research Centre for Orchids, Pakyong, Sikkim for researchers, botanists, orchid growers/lovers, stakeholders and entrepreneurs. The application is built on minimum sdk version 4.1 and target sdk version 10.0 android smartphones.

Key Words: Android Application, Android studio and Orchids, Software development kit, SQLite DB

Introduction

Orchids are the most fascinating flowering plants on the earth and represent incredible range of diversity in shape, size, colour, structure and appearance (Singh *et al.*, 2019a). Orchidaceae is the second largest family of flowering plants, represented by 22,500 species in 800 genera distributed throughout the world (Mabberley, 2008; Singh *et al.,* 2019a; Pamarthi *et al*., 2019). It is estimated that about 1263 species (155 genera) of orchids are found in India, with the Himalayas as their primary home and others scattered in Eastern and Western Ghats; among the 1,263 species, nearly 311 are endemic species (Singh *et al.,* 2019a). The distribution of orchids species in different regions of India is as follows *viz.,* North-Western Himalayas (200 species), North-Eastern India (800 species), the Western Ghats (300 species). Due to its peculiar gradient and varied climatic conditions, North-Eastern India harbours the largest group of temperate, sub-tropical orchids. The species diversity is highest in Arunachal Pradesh, with 612 species, and Sikkim has the richest and most diversified with 560 species of orchids (Singh *et al*., 2019a).

Some of the orchids are used as medicine, food and integral part of socio-cultural events (Medhi and Chakrabarti, 2009 and Meitei et *al*., 2019). Orchids are also used for like preparation of traditional artefacts made from dried leaves of *Cymbidium* in Sikkim (Singh *et al.,* 2019b). The wild species of orchids were used as progenitors in breeding programmes and intra and inter-sectional compatibility found at the species level for development in modern hybrids (Devadas *et al.,* 2016). Pamarthi *et al.* (2019) reported 90 wild species of orchids having potential breeding value and utilized in the development of hybrids or improved lines. The indigenous orchid species *viz*., *C. eburneum*, *C. erythraeum*, *C. hookerianum*, *C. iridiodes, Paphiopedilum druryi, Vanda coerulea* and *V. tessellata* are widely utilized in different crop improvement programmes. Some of the native species of orchids have a significant role in developing the particular trait or character modern hybrids or varieties like *Cymbidium iridiodes,* a native scented species used as a male parent in developing two scented lines (Pamarthi *et al.,* 2019). Devadas *et al.* (2019) attempted to develop the new hybrid having potential ornamental value by using native *Phaius* species (*P. flavus*x *P. tankervilleae*).

With the availability of significant diversity in the morphology of orchid species, identification of wild

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species is a major challenge during germplasm expedition. Tomar *et al.* (2019) developed the "Orchid farming" android application recently for the cultivation of five genera of orchids which gives benefit to orchid growers and farmers. Enormous information about orchids are compiled in a single android application compatible with all smartphones. In continuation, the ICAR-National Research Centre for Orchids, Pakyong, Sikkim has developed an Android-based mobile application named 'Orchidopedia' which provides the quality and collective information on every aspect of orchid species according to their genera. The android app can be downloaded from the Google Play Store that contains 172 species (56 genera) of orchids of the Himalayan region. The work is initiated after the compilation of information of important orchid species.

Further, the application data is updated as per current research data procuring. This android application provides details about classification, distribution, morphological description of orchids. The present generation is well versed with the usage of Android smartphone for their standard requirement. This application support target SDK version Android 4.1 (API level 16) to Android 10.0 (API level 30) mobile phones, which cover almost 96.4% of Android smartphones being used in our country (Tomar *et al.,* 2019). The details of the Orchidiopedia application are given in Fig. 1. Mobile applications allow companies to transform every sector, and now it is marching towards the agricultural industry. Android are less costly than IoS, and a wide range of android smartphones are available in the market for users. Because of the merits of the android, this simple, offline and effective application is developed to transfer scientific information to the botanists, researchers, students and farmers.

Material and Methods

The android mobile application "Orchidopedia" was developed at the ICAR-NRC for Orchids, Pakyong, Sikkim, during 2019. It was built for encapsulating 172 species belonging to 56 genera (Table 1) and their respective species in one hand held device.The floristic nomenclature consultation of each species was confirmed from the online databases, namely, Govaerts (2012), Tropicos (2018), IPNI (2018), eFloras (2018), Plantlist (2019) and POWO (2020). Each species is provided with classification, habitat, distribution, morphological description, key characters, flowering

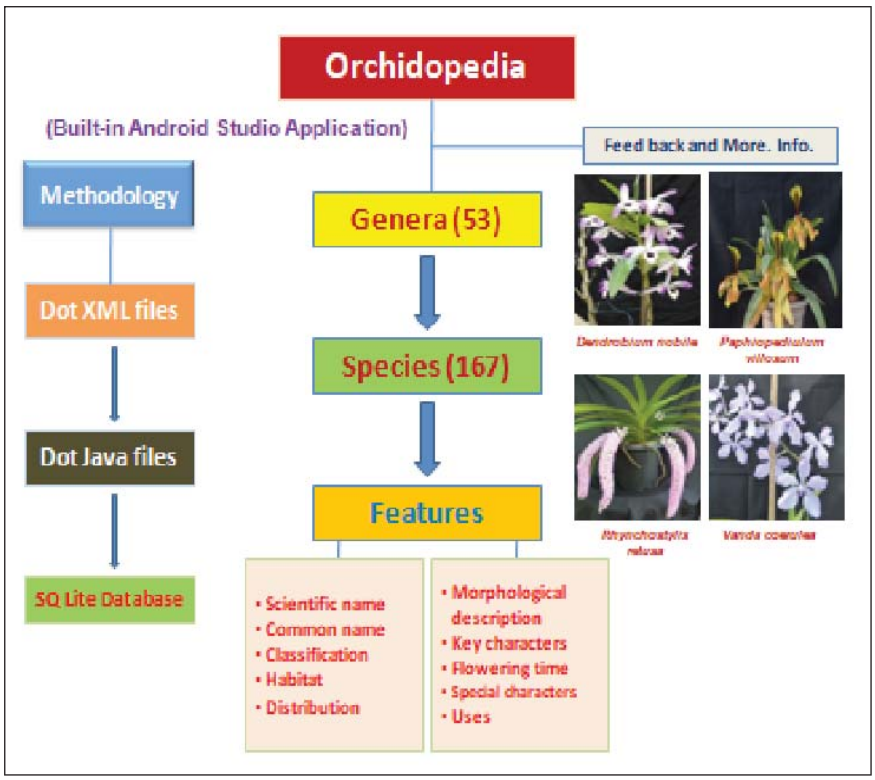

Fig. 1. Outline of the Flow Chart of 'Orchidopedia'

Table.1. List of Orchid species (Genus-Species) used for developing "*Orchidiopedia*" mobile application

S. No.	Genus	Number of species	Details of Species
1	*Acampe*	2	*A. praemorsa, A. rigida*
2	*Acanthephippium*	1	*A. sylhetense*
3	*Acrochaene*	1	*A. punctata*
4	*Aerides*	4	*A. crispa, A. multiflorum, A. odoratum, A. rosea*
5	*Agrostophyllum*	1	*A. brevipes*
6	*Anthogonium*	1	*A. gracile*
7	*Arachnis*	1	*A. labrosa*
8	*Arundina*	1	*A. graminifolia*
9	*Ascocentrum*	2	*A. ampullaceum, A. aurantiacum*
10	*Bulbophyllum*	11	*B. affine, B. careyanum, B. cauliflorum, B. crassipes, B. guttulatum, B. gymnopus, B. hirtum, B. leopardinum, B. odoratissimum, B. viridiflorum, B. wallichii*
11	*Calanthe*	5	*C. biloba, C. chloroleuca, C. herbacea, C. plantaginea, C. sylvatica*
12	*Cattleya*	1	*C. bowringiana*
13	*Ceratostylis*	1	*C. subulata*
14	*Chiloschista*	1	*C. parishii*
15	*Cleisostoma*	1	*C. linearilobatum*
16	*Coelogyne*	5	*C. corymbosa, C. cristata, C. fuscescens, C. nitida, C. Punctulata*
17	*Conchidium*	1	*C. muscicola*
18	*Cymbidium*	8	*C. aloifolium, C. dayanum, C. devonianum, C. eburneum, C. elegans, C. ensifolium, C. hookerianum, C. tigrinum*
19	*Dendrobium*	47	*D. aduncum, D. amoenum, D. anceps, D. aphyllum, D. aqueum, D. bensoniae, D. bicameratum, D. capillipes, D. cathcartii, D. chrysanthum, D. chrysotoxum, D. crepidatum, D. densiflorum, D. denudans, D. devonianum, D. eriiflorum, D. falconeri, D. farmeri, D. fimbriatum, D. formosum, D. gibsonii, D. heterocarpum, D. hookerianum, D. kingianum, D. lindleyi, D. lituiflorum, D. loddigesii, D. longicornu, D. macrostachyum, D. infundibulum, D. jenkinsii, D. moschatum, D. nanum, D. nobile, D. ochreatum, D. parishii, D. pendulum, D. porphyrochilum, D. praecinctum, D. primulinum, D. rotundatum, D. ruckeri, D. stuposum, D. terminale, D. thyrsiflorum, D. transparens, D. williamsonii*
20	*Diplocentrum*	1	*D. recurvum*
21	*Diplomeris*	1	*D. hirsuta*
22	*Epidendrum*	3	*E. ellipticum, E. radicans, E. xanthinum*
23	*Eria*	8	*E. coronaria, E. ferruginea, E. globulifera, E. javanica, E. lasiopetala, E. porteri, E. tomentosa, E. vittata*
24	*Eulophia*	1	*E. speciosa*
25	*Gastrochilus*	2	*G. acutifolius, G. dasypogon*
26	*Geodorum*	1	*G. densiflorum*
27	*Goodyera*	1	*G. procera*
28	*Herpysma*	1	*H. longicaulis*
29	*Hygrochilus*	1	*H. parishii*
30	*Liparis*	3	*L. manni, L. plantaginae, L.viridiflora*
31	*Lycaste*	1	*L. cruenta*
32	*Micropera*	2	*M. obtusa, M. pallida*
33	*Neogyna*	1	*N. gardneriana*
34	*Ornithochilus*	1	*O. difformis*
35	*Panisea*	2	*P. demissa, P. uniflora*
36	*Paphiopedilum*	6	*P. fairrieanum, P. hirsutissimum, P. insigne, P. spicerianum, P. venustum, P. villosum*
37	*Papilionanthe*	2	*P. teres, P. uniflora*
38	*Pelatantheria*	1	*P. insectifera*
39	*Phaius*	3	*P. flavus, P. mishmensis, P. tankervilleae*
40	*Phalaenopsis*	4	*P. deliciosa subsp. hookeriana, P. lobbii, P. mannii, P. taenialis*
41	*Pholidota*	3	*P. articulata, P. imbricata, P. Rubra*
42	*Phreatia*	1	*P. elegans*
43	*Pinalia*	2	*P. amica, P. Pumila*
44	*Pleione*	2	*P. maculata, P. praecox*
45	*Renanthera*	1	*R. imschootiana*
46	*Rhynchostylis*	1	*R. retusa*
47	*Satyrium*	1	*S. nepalense*
48	*Schoenorchis*	1	*S. gemmata*
49	*Smitinandia*	1	*S. micrantha*
50	*Sunipia*	4	*S. bicolor, S. cirrhata, S. intermedia, S. scariosa*
51	*Thrixspermum*	1	*T. musciflorum*
52	*Thunia*	3	*T. alba, T. alba var. bracteata, T. marshalliana*
53	*Uncifera*	1	*U. obtusifolia*
54	*Vanda*	7	*V. alpina, V. coerulea, V. cristata, V. pumila, V. stangeana, V. tessellata, V. testacea*
55	*Vanilla*	1	*V. planifolia*
56	*Zygopetalum*	1	*Z. maculatum*

time, special characters and uses. The original data for each of the sections were sourced from institute reports like annual reports (ICAR-NRCO, 2017; 2018; 2019) and technical bulletins and arranged as per the application's data structure. There are different slabs in each genus that provide information about the genus and their related species. Users can also identify Orchid's species by the high-resolution images and while there is an option of selecting genus and species in the application. The application"Orchidopedia" is built-in Android Studio applicationan Open Source software. Java Core Library provided most functions of the application and the Gradle-advanced build toolkit, to automate and manage the build process leads to the define flexible custom build configurations (Developers Android, 2020). For the creation of this application, two file formats were used. Firstly dot XML files that give design support of application and secondly, dot JAVA files that provide backend programming support. Default permissions, namely *"android.permission.INTERNET"* and *"android.permission.SEND_SMS"* had enabled in the AndroidManifest.xml file of the application, which users need to allow these permissions for using *Feedback* options. Due to the installation of SQLite Database in user's smartphone the application fetches or retrieves massive data of orchid in offline mode also (Fig. 2). This is the inbuilt software of the android operating system which is compatible with the application and store information that the application needs to display to users. It is just like a small pack of databases connected with application. When the application is installed from Google Play Store, it gets attached and provides offline service to the users. In SQLite Database, data are sub-divided into attributes which helps to split according to the user's need. As per user reliability, the hide-unhide feature is enabled because of the enormous data displayed on single screen users who can easily select information according to their needs. The application size is not more than 18 MB which will work on any device without acquiring much space.

Results and Discussion

The genus *Dendrobium* represented the highest number of species (48), followed by *Bulbophyllum* (11), *Cymbidium* (8), *Eria* (8), *Paphiopedilum* (7), *Pinalia* (7), *Vanda* (7), *Pholidota* (6), *Coelogyne* (5), *Calanthe* (5), *Aerides* (4), *Liparis* (4), *Papilonanthe* (4), *Phalaenopsis* (4), *Pleione* (4), *Sunipia* (4), *Liparis* (3), *Micropera* (3), *Phaius* (3), *Thunia* (3), *Gastrochilus* (2), *Panisea* (2), *Phreatia* (2), *Acampe* (2), *Ascocentrum* (2); and 28 genera represented single species. Each species contain ten specific features viz. taxonomical classification, habitat, distribution, flowering time, morphological description and economic importance. Each genus and species are arranged in alphabetical order so that the viewer can quickly check the species level information. Taxonomical classification of each species arranged from class to species level. Status of IUCN of each species is also provided to know the distribution of frequency level of each species. Morphological descriptions and key characters were given to understand the characters of the species. High resolution images also provided to each species for identification. Flowering time, habitat and distribution gives valuable information for explorers and collectors. This application also provides the economic usage of orchids to the users.

How to Use?

"Orchidopedia" app allows users to know information as per requirement in simple and straightforward ways and screenshots (Steps-6), which provide an example of functionality.

- Start the application after downloading from Google Play Store. In Fig. 3 splash screen displayed that will take time to load the SQLite Data with the application.
- As shown in Fig. 4, after full loading of application, a screen occurs that contains *Genera*, *More Information* and *Feedback* option.
- While clicking on the genera option, 53 genera unhide systematically, and user can select any genus as per their choice. For instance, in Fig. 5, we decided on *Dendrobium*.
- Each genus contains the name of its related single or multiple species. As shown in Fig. 5, *Dendrobium* genera listed out various species by their scientific name.
- While selecting *Dendrobium nobile* in Fig. 5, details of related species occurred with subheadings, for instance, common name, botanical name, image, tribe-sub tribe, morphological information, flowering time, etc.
- Users can easily hide/un-hide data as per their need. This functionality gives vital help while accessing particular species detail.
- *Feedback* includes email service and messaging

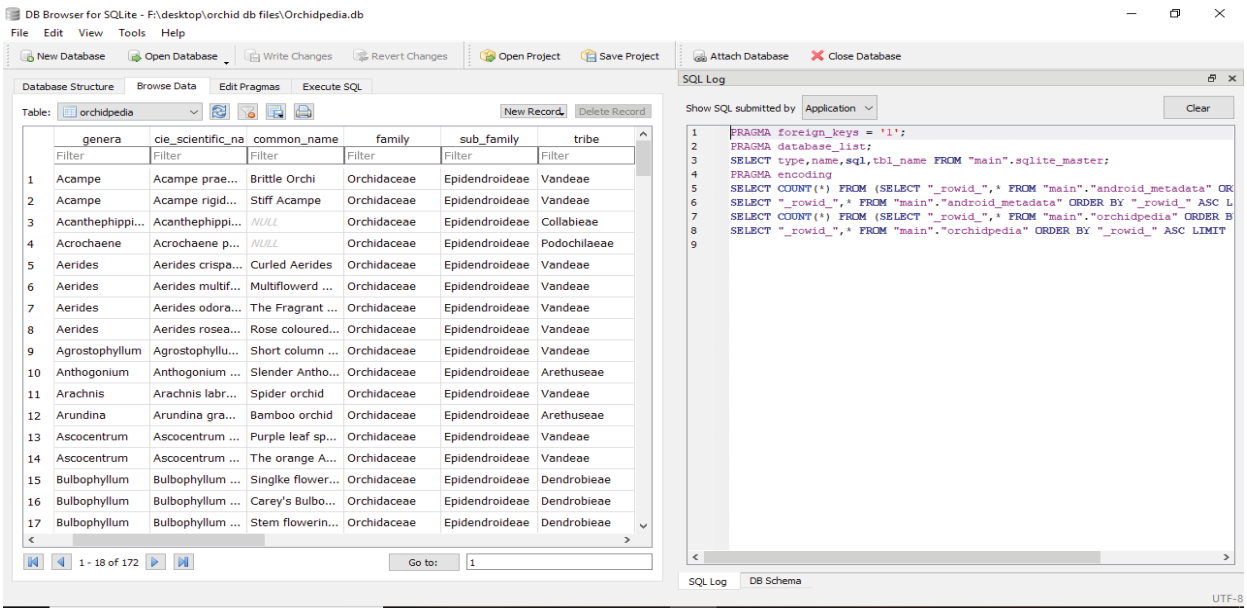

Fig. 2. In-built SQLite Database in browser

Fig. 3. Splash screen and home screen

Fig. 4. List of genera unhide after clicking genera option tool bar and select any species

Fig. 5. Information of selected species

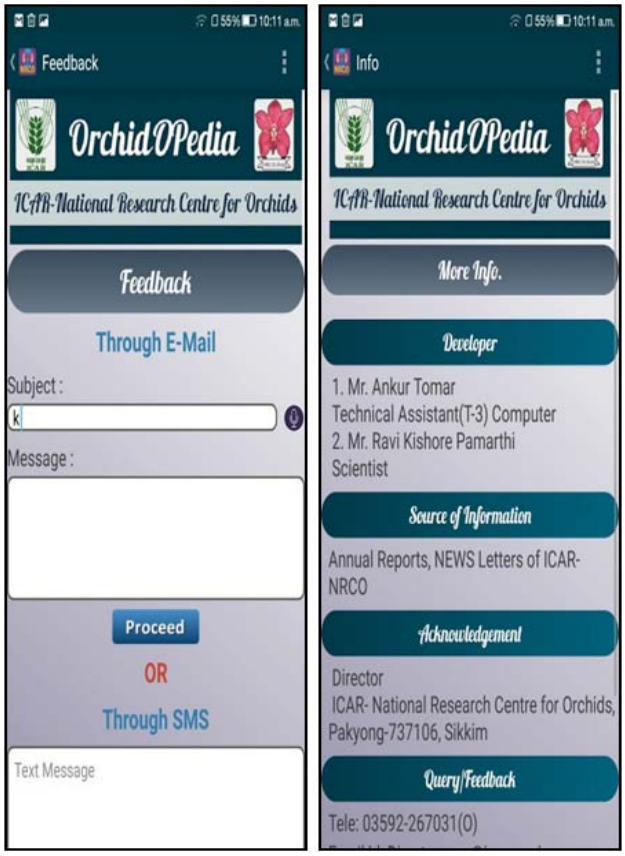

Fig. 6. Feedback form and more information

service that helps orchid growers communicate with us in respective areas (Fig. 6).

- *More Info* & *About Us* gives detail about the institute and their developer info which will assist the userin performing the desired work smoothly (Fig. 6).
- The *menu* option is also attached with the application that helps users can go directly to the main menu from any stage.

Conclusion

In India, most of the orchids are distributed in North-East India and some of the native genera like *Cymbidium, Paphiopedilum, Vanda, Arachnis* and *Dendrobium* are cultivated on a large scale for cut flower production. The *Cymbidium* is grown in NEH Region, mainly in Sikkim, Darjeeling hills, Arunachal Pradesh, Mizoram and Assam. By using this android application, explorers, collectors, orchid growers, students, researchers, botanists, horticulturists, and farmers across North-East India will surely identify wild species of orchids. This mobile app will be helpful in searching of information about wild species. Publication of applications under Google Play store available in public domain including the non-governmental organization, consumers and policymakers. It is a standalone application and freely available and is now in the english language option due to the management of vast orchid data. However, the option "*language selection*" is included as per users' requirement and their responses. Feedback and suggestions about the features and functionality of application have also provided in app. Orchid lovers have already downloaded the application in India and also in other countries. So far, 900+ users have downloaded this application from google playstore [Fig. 7] (Google Play Console, 2021).

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Fig. 7. Information of number of Users who downloaded the application

Conflict of Interest: The authors declare that they have no conflict of interest.

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