IBIN Mobile App: Count for Biodiversity

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ABSTRACT: It is argued that a large fraction of species is facing the threat of extinction without any accurate estimation of how many of them are discovered. With the advantage of information and communication technology and crowdsourcing, a mobile application is designed and developed based on the idea of user-generated content, web-based crowdsourcing application by integrating the location as a parameter and android mobile devices as a small effort for increasing the digitized inventory of country's bioresources. This mobile application is developed for the Indian Bioresource Information Network (IBIN) to integrate the end user data along with the bioresource database. IBIN is a digitized inventory of the biological resources of India that serves as a common platform to access spatial and non-spatial information about the bioresources and data holders can host their data through this gateway with full privileges. The IBIN mobile application is based on the crowdsourcing approach, to collect data on plant, animal, marine, spatial distribution and microbial resources from a large group of crowd to increase the repository of IBIN database which will helps us in the conservation of nature. The biggest advantage of using crowdsourcing is timely data integration at a very low cost but may suffer in data quality. For data verification, an information system is developed through which the experts will verify the crowdsourced data and then, it is available for the users to visualize through the IBIN portal. This will surely increase the datasets available under the IBIN repository.

INTRODUCTION

Nowadays, a large fraction of species are facing the threat of extinction and we have no clear idea that how many species have been discovered and described till now and how many of them are yet to be discovered. Certainly, due to the lack of this information, it is difficult for the professionals to plan for the conservation of bioresources. To address this problem, Department of Biotechnology had launched a national project known as Indian Bioresource Information Network (IBIN). IBIN is a digitized inventory of the biological resources of India garnished from the published information (Natesh, 2006). IBIN functions as a common software platform where the compiled information on various economical plants, medicinal plants, animal and microbial resources (from across India) are served to a diverse range of end users. These biodiversity and bioresource datasets are accessible through IBIN in various forms such as spatial datasets and non-spatial datasets. Spatial datasets are available through IBIN spatial node and non-spatial datasets are available through IBIN species node. IBIN spatial node provides vegetation type map, fragmentation, disturbance index and biological richness in 1 km x 1 km aggregated grids and also grided species data collected for Biological richness modeling (Saran et al., 2012). In IBIN, OGC's Catalog Service for the Web (CSW) is implemented to offer the access of this geospatial information over the Internet. Non-spatial datasets refer to the species datasets containing data on the medicinal and economically useful plants, animal, marine and microbial resources of the country. These data are stored in the database and are accessible to the users while querying from the database. Today, IBIN is handling the record of 39,000 species (Saran et al., 2012). But, it is not possible to get data from every corner of the India because the data are highly scattered and not easily accessible. So, the vital concern is on how to complete the inventory of the biological library of the country. Based on the aforementioned problem, it is clearly understood that comprehensive information about the bioresources is required and to achieve this, there should be an information system for the collection of data from various sources. As it is known, data, human resources and technology are the three important sources, which played a key role in any organizational activities (Jain et al., 2015). To carry out the wide range of activities with the involvement of social media, crowdsourcing concept is implemented to make individual tasks possible with clear endpoints that might take weeks or even months of expert-level effort. "Crowdsourcing" is a term defined by Jeff Howe in 2006, refers to a type of business in which "jobs are outsourced to a large group of people in the form of an open call" (Howe, 2006). Crowdsourcing can be defined as an approach to obtain ideas, services or contents by distributing labor to a large group of people (crowd), which can be further used in a scientific research (Yarbrough, 2011). The

successful implementation of crowdsourcing can be achieved by developing the crowdsourcing tools using the applications of information and communication technology (ICT), especially mobile application. As of now, data collection is getting easier through human resource and mobile technology because mobile devices are equipped with the various capabilities such as geolocation, camera, light, audio and visual sensors and much more multi-sensing capabilities. This principle of crowdsourcing and implementation of ICT led to the development of a crowdsourcing based mobile application as a concerted effort for gathering the information on bioresources in which human resources are used as an asset to collect data and send them to us by using the mobile devices and internet technology. According to the 2015 International Telecommunication Union (ITU) report (ITU, 2015), there are more than 7 billion mobile users and 3.2 billion internet users, among them 2 billion are from the developing countries. It is prima facie that access to ICTs and its applications are growing consistently (Ugwuishiwu et al., 2013) by providing the better quality of service and reducing the number of errors in research and development (Shahriza et al., 2006). As defined by The World Bank Group, 2003, ICT is a diverse set of technical tools or means to store, retrieve, manipulate and communicate data and information electronically in a digital format. The ICT sector comprises of infrastructures such as hardware and software, networks, media for collection, and information technology for processing, transmitting and disseminating the information (Ebijuwa, 2005; Anyakoha, 2005). The major components that are required to perform the function of ICT system, are people, data, procedures, software, hardware and information (ictamymccarthy, 2017). Floridi, 2007 broached two terms to describe the influence of ICT, infosphere and re-ontologizing. Infosphere is derived from "biosphere", signifies that portion of planet where is life and full of all informational entities, it can be seen as similar to cyberspace but it is little bit different because it contains offline and analogue spaces of information. Another term, re-ontologizing refers to re-engineering that includes the design and structure of a system anew. Using these two terms, Floridi, 2007 concluded that ICTs were re-ontologizing the every aspects of infosphere. This logic is ratified by observing the unprecedented changes and transformations in both, public and private sector, which have been bought up by ICT (Floridi, 2007). Among the enormous benefits experienced by the use of ICT, the most popular one is the access of internet, which is now used as a biggest repository of information and knowledge, the role of professionals have been changed from intermediate to facilitator, new tools are developed for the proliferation of information worldwide (Stawnicza, 2014). The effective and efficient usefulness of ICT can be seen in various application like e-Government, e-Commerce, e-Education, e-Health and e-Environment (ITU, 2015).

As explained by Hursen, 2011 about the life-long learning competencies, he defined one of the competencies, i.e. information retrieval competency, for this process there should be an ability to establish a broad communication to deliver thought and information on any subject or issue, ability of using mechanism to reach to the information by using mobile technology and internet. Based on these considerations, a mobile application of IBIN is developed with a sophisticated user-friendly design in order to improve the repository by getting access to a huge variety of data related to bioresource. A mobile application is a piece of software application designed to run on a portable devices such as mobile phones, personal digital assistant (PDA) or tablet, facilitate users to access technology and services like accessing Internet, making payments and other transactions, playing games, sending emails and messages, etc (George et al., 2011).

The goal of IBIN mobile application is to retrieve and store data on plant, animal, marine, spatial distribution and microbial resources shared by the users on a daily basis which is then processed as an information to be made available for the professionals involved in bio-prospecting, marketing, protecting bio-piracy and conservation of bio-resources. Therefore, the main focus is to make IBIN mobile application a social networking tool to collect as much information as possible.

Development of a mobile based application namely IBIN mobile app for improving the repository by getting access to a huge variety of data related to bio-resource is described in this paper.

MATERIALS AND METHODS:

The section briefly describes the technologies and methodology used in the designing and development of IBIN mobile app.

Technologies:

There are multiple framework to develop an app as there are multiple mobile platforms. Suppose, when an application is developed in Android Studio framework, that application will be platform-dependent, i.e., it will run only on android operating system, not on other operating system. These platform-dependent apps are known as native apps which are only designed to execute on a particular operating system or platform by targeting the software development kit (SDK) and framework of that platform (mobiForge, 2017). For example, android apps are built on Android SDK, windows app are built on Visual Studio, apps for iOS are using iOS SDK (iPhone SDK), and so on. Therefore, developing an app

separately for each platform consume time, cost and resources. This led to the idea of hybrid mobile application. Hybrid mobile application is a mobile application based on cross-platform approach which is built using web technologies such as HTML5, CSS and JavaScript, and then it is hosted inside a client-side native container to access the hardware capabilities of the device (Heitkötter et al., 2013). The IBIN mobile app is based on the hybrid mobile web application which uses Apache Cordova framework (Apache Cordova, 2017). Apache Cordova (Babu et al., 2012) is an open source framework, based on hybrid approach, provided by Apache Software Foundation (ASF) for mobile web application development.

SYSTEM ANALYSIS AND DESIGN

The IBIN mobile app has been developed using UML (Unified Modelling Language), a universal language to express all the processes of the software as a model (Booch et al., 1998), comprises of the following diagrams:

i. Use Case Diagram: - This is used as a tool to define the functional requirements of a system, where functions are shown as a use cases and the relationship between users and use cases (Shen & Liu, 2003).

ii. Activity Diagram: - This is used as a tool to define the working of an application in a sequence, i.e., concurrent activities of the software (Kim et al., 2007).

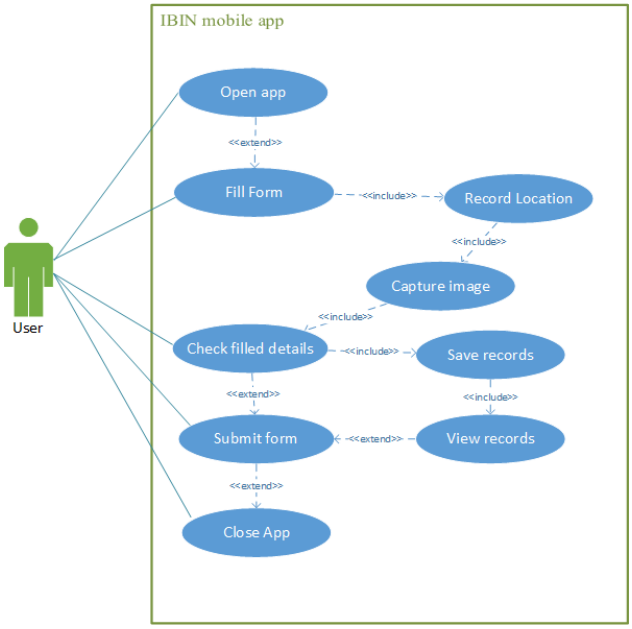


Fig. 2. (a) Use Case Diagram

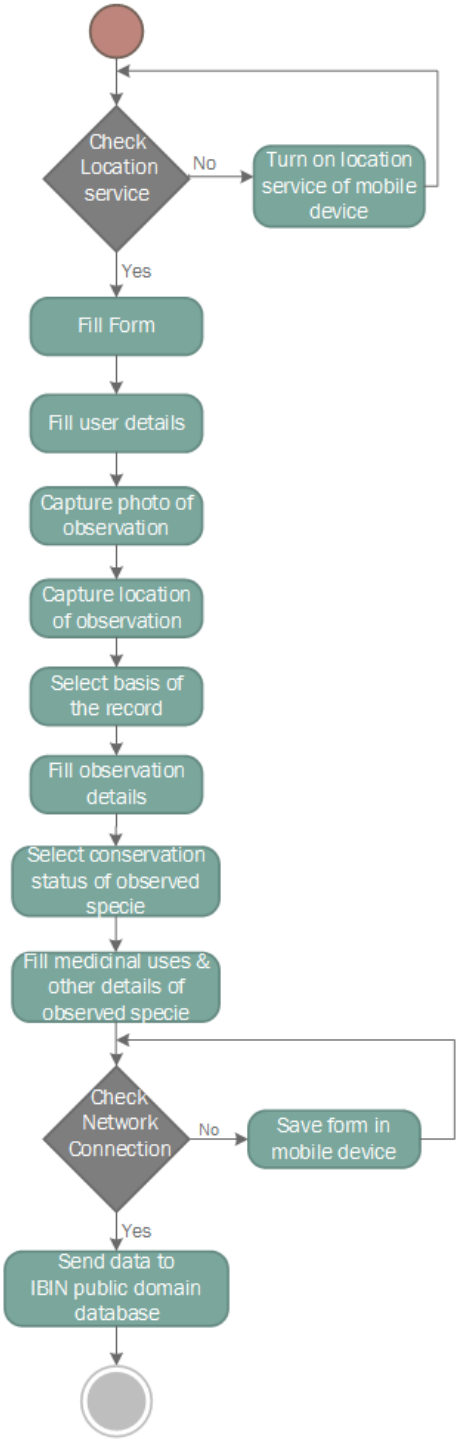


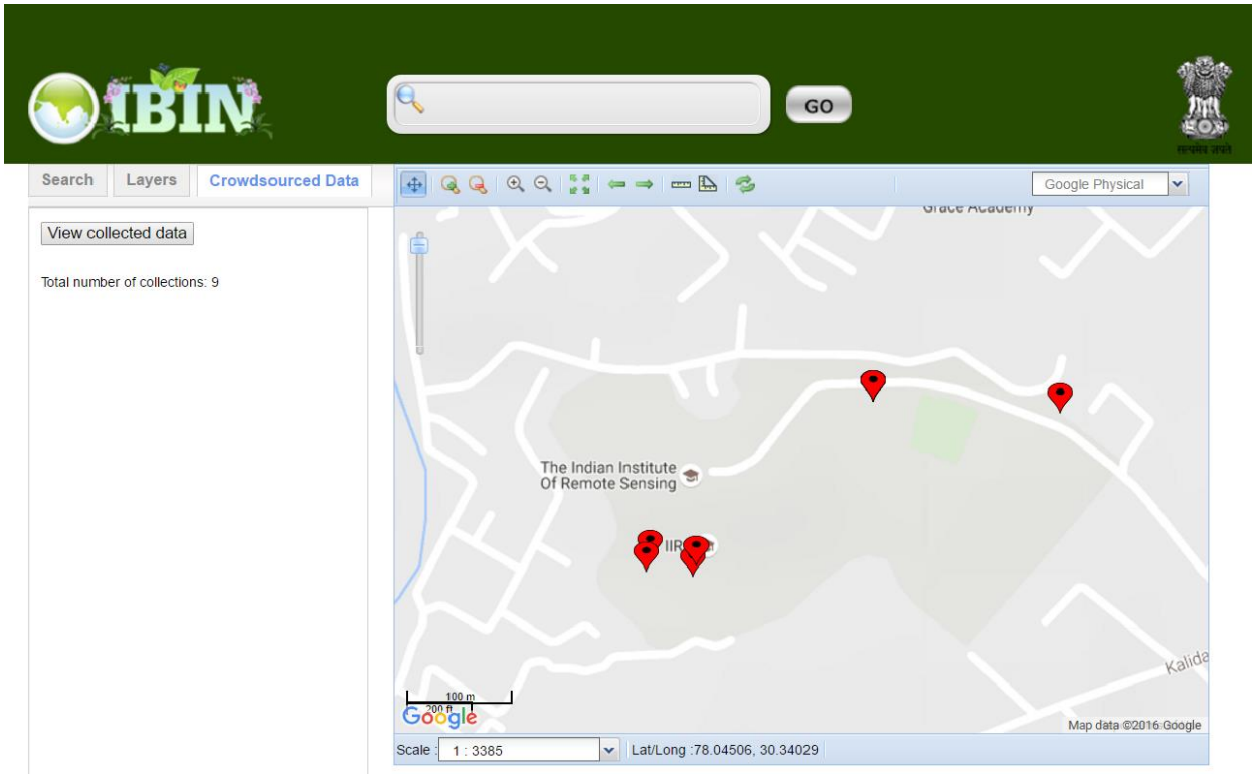
Fig. 2. (c) Activity Diagram of IBIN mobile app

After the creation of UML diagrams, the next step is to the design and development of an application based on these analysis and design.

APPLICATION DESIGN AND DEVELOPMENT:

The first part of application design and development is the design and development of IBIN mobile application. The IBIN mobile application is accomplished in two parts - front end and back end. The front end part contains the designing of the application interface using Apache Cordova for presenting the application in a well-defined style and matter to user in order to make it user friendly. As a result, the users are able to access the activities such as entering into the application, exiting from the application, filling the form related to their observations, recording their location and capturing the image of their observations and sharing their data by sending their records. But, the data sharing is only possible if there is an Internet connection. In case of no internet connection, a facility of saving the data is provided in a mobile app, so that, the user can send their data whenever the internet connection will be available. This work is done by using the IndexedDB API of HTML5, which stores the data in the database of web browsers persistently (W3C, 2005) in the form of objects along with a unique key. The back end part is not visible to the user and it runs on the server to process the requests received from the client and send the responses back to the client for their sent requests. It is developed using server side language such as PHP and PostgreSQL to be connected with the database and store the user's data into the IBIN public domain database.

Now, the second part of this application is the visualization of crowdsourced data in IBIN portal. The IBIN public domain welcomes all the data sets submitted by the mobile app users and the users can view their send data on IBIN portal.



RESULTS AND DISCUSSIONS

The outcome of the design and development of IBIN mobile app is shown in the figures 3 (a) to 3 (h) as mentioned below:

i. Fig. 3. (a) shows the welcome screen, with the warning to turn on the location service of mobile, otherwise, it will not redirect to the next page
ii. Fig. 3. (b) shows the first page where sender has to give some mandatory information about himself/herself,
iii. Fig.3. (c) shows the second page to capture the image of observation by taking photo via camera or by choosing it from gallery of mobile device with no restriction on the size of image (required field)
iv. Fig.3. (d) shows the third page to record location of the observation and the accuracy should be less than thirty meter (required field),
v. Fig.3. (e) shows the fourth page for selecting the basis of record on which the observation is based as a mandatory field,
vi. Fig.3. (f) shows the fifth page to fill the required details related to the observation as an optional data,
vii. Fig.3. (g) shows the sixth page to select the status of the conservation of the observation,
viii. Fig.3. (h) shows the seventh page to fill the required details related to the medicinal uses, its management and the details of associated species found as an optional data, and
ix. Fig.3. (i) shows the last page. This page appears when the data successfully sent to the IBIN server.

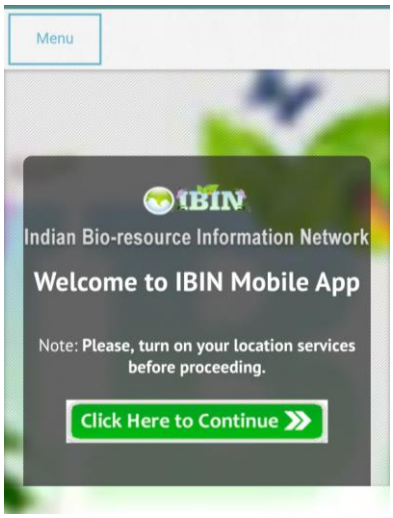


Fig.3. (a)

Fig.3. (b)

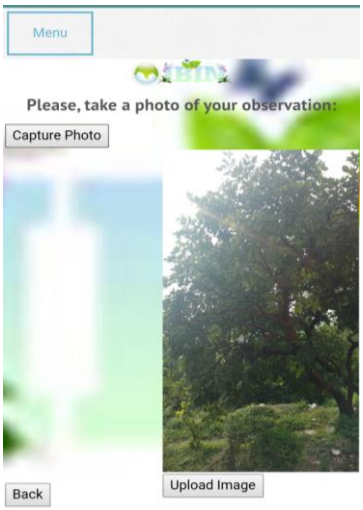


Fig. 3. (c)

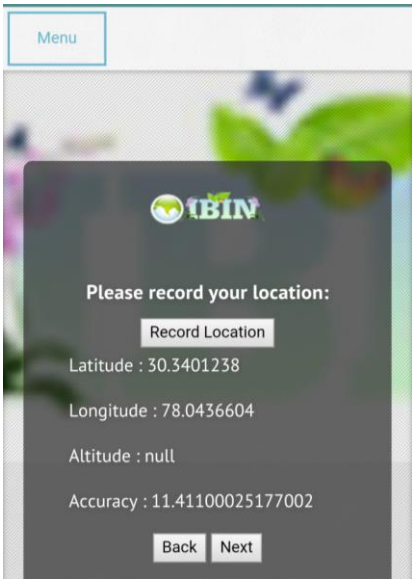


Fig.3. (d)

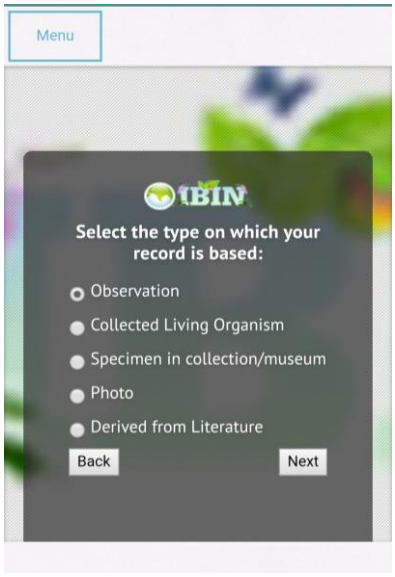


Fig.3. (e)

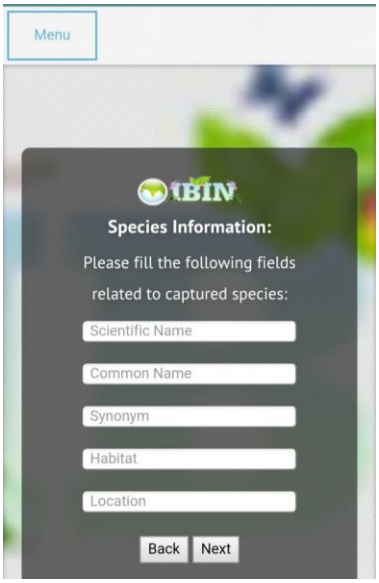


Fig.3. (f)

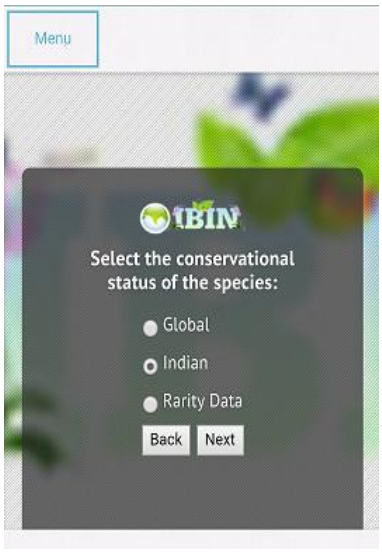


Fig.3. (g)

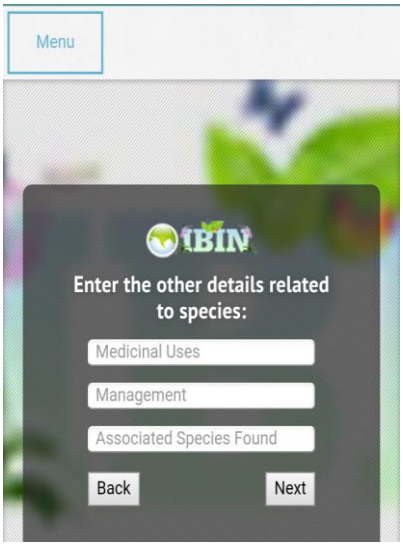


Fig.3. (h)

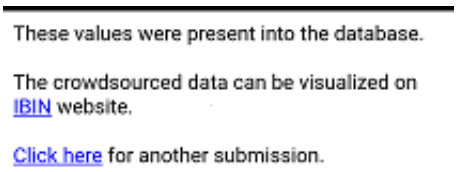


Fig.3. (i)

Data Validation:

For data validation, various validation rules are defined at the point of data entry by the user to satisfy the objectives and requirement of the project (Kennedy, 1997). For an example, as shown in given fig. 4. (a), wrong email address was entered followed by clicking on the on next button, resulting into an alert message generation regarding the invalid email address (Fig.4.(b)). Likewise, many validation rules have been used in this app to validate the data to be entered by the users.

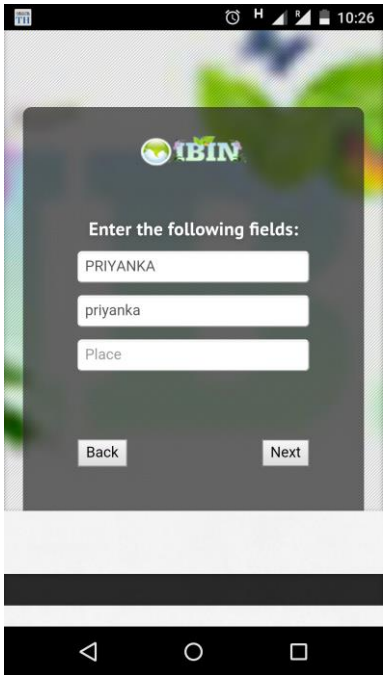


Fig. 4. (a) Entry of wrong email id

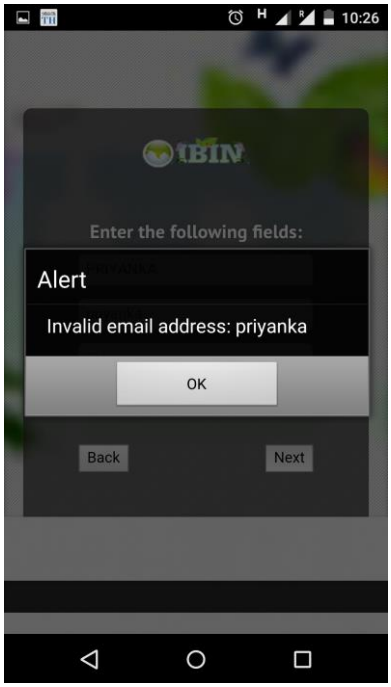


Fig. 4. (b) Validation of data input and generation of alert message

CONCLUSION

Crowdsourced applications bear the evidence that crowdsourcing has the potential to bring together a large group of people on the same platform to share their ideas and contents. In terms of data collection, crowdsourcing is found to be most effective and economical in the cases where the user base is small. Taking this aspect into account, a user-friendly platform intendent mobile application namely IBIN mobile app has been developed to retrieve and store data on plant, animal, marine, spatial distribution and microbial resources being shared by the users on daily basis. To make the crowdsourced data available for the professionals involved in bio-prospecting, marketing, protecting bio-piracy and conservation of bio-resources, firstly it is required to convert them into the valuable information using the data quality check process. Data quality check is necessary because much more data may come from various places, among them some of the data may be useless. The data sets submitted by data providers will not be available immediately to IBIN web portal. The data and information will be published into IBIN after certain quality check. The quality check team at IBIN administrator will try in least possible timeframe to submit their report to IBIN database administrator. The IBIN DBA will send QC report to data provider and publish along with proper credit and ownership to data provider or reject the data as per QC report. The metadata information is necessary to publish the submitted data once the submitted data will be published into IBIN. Therefore, the extraction of data is required to done to select the relevant one after being identified by the researchers followed by storing into the database.

REFERENCES

Anyakoha, M.W., 2005. Information and Communication Technology (ICT) in library services. Coal City Libraries, 2(1&2), pp.2-12.

Apache Cordova, 2017. Retrieved September 21, 2017, from https://cordova.apache.org/.

Babu, R.M., Kumar, M.B., Manoharan, R., Somasundaram, M. and Karthikeyan, S.P., 2012. Portability of mobile applications using phonegap: A case study.

Booch, G., Rumbaugh, J. and Jacobson, I., 1998. The Unified Modeling Language User Guide: The ultimate tutorial to the UML from the original designers. Addison-Wesley.

Ebijuwa, A.A., 2005. Information and Communication Technology in university libraries: The Nigeria experience. Journal of Library and Information Science, 7(1&2), pp.23-30.

Floridi, L., 2007. A look into the future impact of ICT on our lives. The information society, 23(1), 59-64.

George, T., Bagazonzya, H., Ballantyne, P., Belden, C., Birner, R., Del Castello, R. and Treinen, S., 2011. ICT in agriculture: connecting smallholders to knowledge, networks, and institutions. Washington, DC: World Bank.

Heitkötter, H., Hanschke, S., & Majchrzak, T. A., 2013. Evaluating cross-platform development approaches for mobile applications. In Web information systems and technologies (pp. 120-138). Springer Berlin Heidelberg.

Howe, J., 2006. The rise of crowdsourcing. Wired magazine, 14(6), 1-4.

Hursen, C., 2011. Ogretmenlerin Yasam Boyu Ogrenme Yaklasimina Yonelik Gorus, Tutum ve Yeterlik Algilarinin Degerlendirilmesi. Doktora Tezi, Yakın Dogu Universitesi, Egitim Bilimleri Enstitusu, Lefkosa.

ictamymccarthy, 2017. Components of an ICT system. Retrieved September 20, 2017, from https://ictamymccarthy.wordpress.com/2012/09/20/components-of-an-ict-system/.

ITU, 2015. ICT Applications – ITU. Retrieved September 20, 2017, from http://groups.itu.int/stocktaking/About/WSISActionLines/C7.ICTApplications.aspx, last accessed December 20, 2015.

ITU, 2015. ICT Facts and Figures 2015, Retrieved September 20, 2017, from http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2015.pdf.

Jain, A., Adebayo, J., De Leon, E., Li, W., Kagal, L., Meier, P., & Castillo, C., 2015. Mobile Application Development for Crisis Data. Procedia Engineering, 107, 255-262.

Kennedy, M. S., 1997. Options in Data Validation: Principles for Checking Analytical Data Quality. Environmental Data Repository. D. Eng, M. Chacko, M. Kanaan, 169.

Kim, H., Kang, S., Baik, J., & Ko, I., 2007, July. Test cases generation from UML activity diagrams. In Software Engineering, Artificial Intelligence, Networking, and Parallel/Distributed Computing, 2007. SNPD 2007. Eighth ACIS International Conference on (Vol. 3, pp. 556-561). IEEE.

mobiForge, 2017. Mobile apps: native vs. web apps - what are the pros and cons?. Retrieved September 21, 2017, from https://mobiforge.com/news-comment/mobile-apps-native-vs-web-apps-what-are-pros-and-cons.

Natesh, S, 2006. Digitized inventory of biological resources of India. CURRENT SCIENCE-BANGALORE-, 91(7), 860.

Saran, S., S., Kushwaha, S. P. S., Ganeshaiah, K. N., Roy, P. S., Murthy, Y. K., 2012. Indian Bioresource Information Network (IBIN): a distributed bioresource national portal, 18.

Shahriza Abdul Karim, N., Hawa Darus, S. and Hussin, R., 2006. Mobile phone applications in academic library services: a students' feedback survey. Campus-Wide Information Systems, 23(1), pp.35-51.

Shen, W., & Liu, S., 2003. Formalization, testing and execution of a use case diagram. In Formal Methods and Software Engineering (pp. 68-85). Springer Berlin Heidelberg.

Stawnicza, O., 2014. Information and Communication Technologies–Creating Oneness in Globally Distributed IT Project Teams. Procedia Technology, 16, 1057-1064.

The World Bank Group, 2003. ICT and MDGs: A World Bank Group Perspective, Retrieved September 20, 2017, from http://documents.worldbank.org/curated/en/538451468762925037/pdf/278770ICT010mdgs0Complete. pdf.

Ugwuishiwu, B.O., Obi, O.F. and Ugwuishiwu, C.H., 2013. Information and communication technologies: Benefits and challenges to the environment. International Journal of Soft Computing and Engineering, 2(6), pp.96-100.

W3C, 2005. Indexed Database API. Retrieved September 22, 2017, from http://www.w3.org/TR/IndexedDB/#database-api.

Yarbrough, J., 2011. A Mobile Computing Crowd Sourcing Application for Reporting Ecological Disasters. Alabama Science and Engineering Fair, Huntsville, AL.