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QR Code Assisted Information Dissemination on Educational Campus – A Prototype

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Abstract - Educational campuses boast a rich diversity of vegetation, tree and plantations of interest. However, the proper identification and further sharing this information with students and other interested stakeholders demand separate efforts. To approach this issue, conventionally, institutes consider affixing information regarding a particular plant / species to the respective tree. This approach suffers multiple trade-offs. Larger type size of letters costs supplemental information of the respective species and paragraphs of information requires shirking of type size of letter which eventually hampers the engagement of the visitor. In order to address these issues, we have attempted to automate this task using Quick Response codes in multiple phases. In the first phase, we attempted to prepare the database of the floral diversity. Subsequently, we integrated this database to a user-friendly Android based mobile-app. This app utilizes the phone camera and allows the user to scan the QR Code. Once the QR Code is scanned, this app decodes the QR Code and if a successful match is found to the unique entry of in the plant database, it is capable to display the information of the scanned species on the mobile screen. For this prototype, we generated unique QR Codes for each of the identified plant species as entered in the database and then these QR Codes were affixed to the select set of vegetation, trees and plants after proper verification and validation. We asked the stakeholders install this app and encouraged them to obtain the information related to different trees across the campus. An informal follow-up survey was conducted where majority of stakeholders reacted affirmatively regarding the usefulness of the prototype in gradually building individual knowledgebase.

Key Words: QR Codes, Android, Python, Flask, SQLite

1.INTRODUCTION

With the ample availability of smartphones and other digital devices and cheaper internet/data plans initially gradual but eventually a remarkable deviation from printed books to their digital alternatives is evident among the students (Heider, 2009). However, the digital revolution has also resulted in a significant rise of screen-time among university students (Deyo, 2024). At the same time an increase in academic performance of students who engage in an interactive digital platform has also been observed (Bertheussen, 2016). While during pre-COVID times, traditional classroom AV aids were the principal means of imparting education, a significant paradigm shift to mobile app based platforms has been observed (Smith, 2018) (Kang, 2021). More than 60 per cent of school students even in the rural part of India have an access of smartphones which is playing an important factor in bridging the digital divide (Ministry of Finance, 2021). Use of mobile apps have been found effective in achieving Required Learning Outcome (Khaddage, 2016).

With an objective to enhance the learning experience of students specifically with the flora, the present experiment was conducted at Anand Agricultural University campus. In its pilot phase, different trees of major species on the campus were selected and tagged with a QR Code sticker unique to the species. A mobile app was developed used to extract and display the information specific to the species from this scanned QR code.

2. RELATED WORK

Quick Response (QR) codes are machine readable, 2-D matrix barcode having black squares in white background capable to store small amount of data for objects, locations etc. (Hara, 2019). Researchers have explored the potential of the QR codes, although available for about more than two decades as an affordable interactive tool in education (Law, 2010). QR codes have significantly assisted in enhancingusers' interactive learning experiences when combined with the smartphones in an affordable manner (Wang 2024). Royal Palace of Naples (Italy) and the Wilanow Palace in Warsaw (Poland) in collaboration implemented QR codes to enhance museum visitors' experience with an interactive environment (Solima, 2018). The effectiveness of QR codes in the academic content for Saudi Arabian educational process is studied along with its significance in transition towards blended learning environment (AlNajdi, 2022). Tourists' experience at the zoo industry is studied and has been made more interactive, personalized and informative by integrating GPS, NFC and Augmented Reality technologies in form the Personal Zoo Assistant (Syerov, 2025).

With the significant penetration of the smartphones along with affordable and the near ubiquitous data connectivity among students, this study has been aimed to improving the learning experience of species information gathering activity during their campus life more interactive.

3. METHODOLOGY

Different programming languages / frameworks were considered for the development of the prototype for the present study namely PHP, .NET and Python. Out of which Python was chosen as suitable for its simplicity and support for the rapid prototyping environment. Similarly, SQLite database engine was opted for being simple and fast but a very small memory footprint, looking towards the fixed number of selected species for the QR database. Android SDK was used to develop the frontend of the prototype. Python based micro web application development framework Flask was used for the backend. The client-server architecture of the prototype is modeled as per the flow diagram depicted in *Figure 1*. The selected plant species are assigned a unique ID as a primary key for identification and storage purpose in the database schema. The same ID is encoded to mobile readable QR codes using the qrcode module of Python. Subsequently, these respective QR codes have been printed and affixed to the plants.

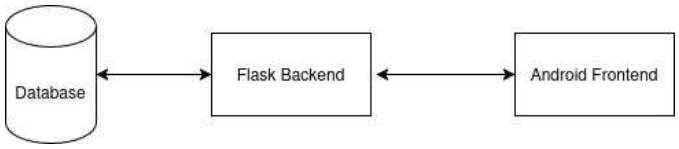

Figure 1 Architecture of the prototype

In this client-server architecture, the Android app written in Java remains as the client side endpoint with camera enabled permissions the client scans a valid QR code affixed on the plant / tree species of the campus which interacts with the hardcoded Flask Application Server URL. This scan is decoded back to the original unique ID which is sent back as a payload to the HTTP requests over RESTFul APIs at Flask application server backend. Subsequently, upon receiving the ID as the payload, the backend interacts with the SQLite database and queries the respective ID for data retrieval. The Flask-SQLAlchemy extension is used as an ORM (Object Relationship Mapping) tool for efficient database interactions with the SQLite database. Upon successful match, the species' data is sent back to the Android app client encapsulated in the JSON format. The Android app which then consumes the API and receives in JSON format, parsing the same to populate UI views with the data retrieved from the server and displays retrieved data for the requested species on the users' screen.

4. RESULTS

Once the system was fully operational with the plant database, API backend and Android app frontend, the system was tested by pasting QR codes on respective trees. While *Figure 2* depicts prototype frontend screen and the process of scanning of QR code under test condition, *Figure 3* displays retrieved information in the vernacular language shown on the user's screen.

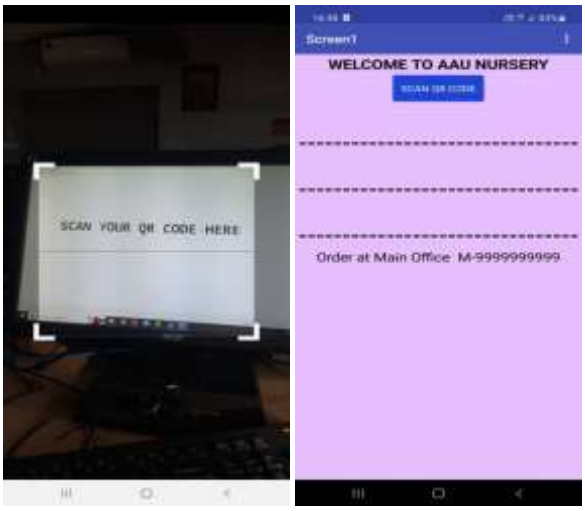

Figure 3 Landing Page of the Android app

Figure 2 Data Display Page of the App

Stakeholders such as students on campus and other staff were encouraged to download the app in their smartphones and also to scan the QR codes affixed on plants / trees while on the go in the campus. *Figure 4* depicts a photo of the user scanning QR code.

Figure 4 Users scanning QR code to identify species

An informal survey was conducted to assess the usability of the prototype app involving about 40 students and staff members as stakeholders. The survey consisted of questions regarding user-friendliness, satisfaction, usage frequency and further improvement of the prototype app. While 75 % of stakeholders responded with satisfied and very satisfied as overall rating, 80 % of stakeholders positively responded to user-friendliness. About 70 % of them shown repeat engagement with usage frequency of more than one in a day, some students also reported *personal bookmarking* and *species-tour* as potential features to include in the future versions.

4. CONCLUSION

The present prototype of the QR Code Assisted Information Dissemination depicts increased user engagement in plant species identification among the students with the central objective of tapping the screen-time of students and diverting the same towards a positive direction making learning process more interactive, user-friendly and on the fingertips.

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