EduBay: A Mobile-Based, Location-Aware Content Sharing Platform

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Abstract. Most natural sciences streams (zoology, botany, anthropology, agriculture etc.) require collecting a lot of artifacts from natural environments to understand their properties such as shape, size and appearance. Currently this is done through what are called "field trips" where students and researchers go to different places and collect/study specimens from that unique habitat. These field trips are mostly very notional since logistically and monetarily they are not very scalable. The interesting locations for field trips may also be quite far and remote from the current user location. We present in this work a location based content brokering platform EduBay where we bring together the *creators* of content (researchers, students or local people who get photographs, videos of the specimens; audio such as bird sounds etc.) and the *consumers* of the content (fellow students and researchers who need these artifacts for their studies). EduBay is built around the mobile platform since collecting audio, video, or photographs from natural surroundings can leverage the camera, microphone, and other sensors on the mobile device. The platform strongly leverages the location sensor on the mobile device to connect a content to its creation location since most of these interesting artifacts can sometimes be found only in some unique locations. The platform presents interesting location centric views to the creator as well as to the consumer for easy discoverability and searching of the content. The platform also provides a mechanism to validate new content or ascertain the value of a content using peer group crowdsourcing. To keep the creation and consumption of the content under balance, the platform keeps check on the creation and consumption behavior of each user and incentivizes them to create good content as much as they consume them.

Keywords: Mobile · Social · Brokering platform · Location based · Images · Audio · Video · Natural sciences · Crowdsourcing · Incentive mechanisms

1 Introduction

Most natural sciences streams (zoology, botany, anthropology, agriculture etc.) require collecting a lot of artifacts from natural environments to understand their shape, size,

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appearance, properties etc. Currently this is done through what are called "field trips" where students and researchers go to different places and collect/study specimens from that unique habitat. These field trips are mostly very notional since logistically and monetarily they are not very scalable. These interesting locations for field trips may also be quite far and remote from the current user location. We present in this work a location based content brokering platform EduBay where we bring together the *creators* of content and the *consumers* of the content. The *creators* of the content can be people who are fellow students or researchers from a location trying to help peer community and earn download credits (described later) for EduBay. It could also be people who are local residents for whom incentives could be in form of monetary benefits such as mobile credits, coupons etc. The content could be specimen photographs (flowers in bloom in a particular season, rare fern species), animal behavior video, audio of bird and animal sounds etc. The consumers of content would mostly be the peer community of students and researchers who are in need of the content. EduBay is built around the mobile platform since collecting audio, video, or photographs from natural surroundings can leverage the camera and microphone sensors on the mobile device. With the help of a mobile device the creator of the content can easily record a video, audio, or photograph of an artifact from the natural environment (without having to disturb or capture it) and upload it to the EduBay platform immediately from the content capture location. This provides a more hassle-free and seamless experience to the content creator who may not be very tech savvy. The platform also strongly leverages the location sensor on the mobile device to connect a content to its creation location since most of these interesting artifacts can sometimes be found only in some unique locations. For example reindeers are found only in the Nordic region or the birds of paradise are mostly found near Papua New Guinea. The platform presents interesting location centric views to the creator as well as to the consumer for easy discoverability and searching of the content.

The EduBay platform provides following unique features to the user:

(1) Seamless Content Creation: Tight integration of camera with the EduBay mobile application so that capture and upload of content to EduBay is seamless.
(2) Easy Discoverability and Search: Location centric views of content on the EduBay mobile application so that the consumer can easily browse through the map and find the content specific to a region.
(3) Request for Content: The consumer can put in a request for some content from a particular location and the creators from that location get notified of the request which they can help fulfill.
(4) Crowdsourced Verification: Not all uploaded content and its metadata may be of good quality. Users can express their vote for a content to verify how good/bad the content quality is.
(5) Fair Usage Policy: To ensure that users also create content as much as they consume them, we have a fair usage policy which allows consumption of content only if there is a reasonable instances of content creation by a user.

The EduBay platform has a creator and consumer application which enables the various functionalities for the roles different users are performing at different times. The content and the metadata are stored in a backend EduBay server consisting of an

Apache web server and a MySQL database. The EduBay mobile application is built on Android platform and the backend server programming is using PHP scripts.

The paper is organized as follows. We review some of the related work on content brokering platform (Sect. 2). We then describe the three components of the mobile client platform – content creation, content verification and content access (Sect. 3). The server piece of the EduBay platform is then described (Sect. 4) which presents the different databases and communication details between the client and the different servers. We conclude the paper with summary, discussions on the potential use cases and some technical next steps.

2 Related Work

The area of crowdsourcing for data collection and crowdsourced verification of the data has recently been a very active area of interest. The interest stems from the availability of more ubiquitous access to internet through mobile devices from which such data can be crowdsourced, and the ability to do small amount of computation during "dead time" while on the move.

Prominent among these are citizen science projects such as SETI Live [1] and Galaxy Zoo [2]. SETI Live provides a platform to harness the power of human computation for detecting interesting signals from outer space which may have help discover extra-terrestrial life beyond our planet. GalaxyZoo initiative helps classify different morphological aspects of galaxy images using the power of crowdsourcing which ultimately helps in the discovery of new galaxies.

There are also some new breed of mobile apps that are coming up which help in crowdsourcing environmental data from different locations through mobile devices. The data could be about the pressure, temperature, noise pollution etc. The mPING project [3] from National Oceanic and Atmospheric Administration helps collect precipitation data from citizens using a mobile application. The data is then presented on a map and further analysis can be done on severe data that are reported from a particular region. The pressureNET app [4] helps collect barometric pressure data from citizens which can then be used to predict very localized weather patterns. [5] uses a smartphone app to crowdsource noise pollution data from urban environments. These collected data can then be used for further modeling and prediction at a much higher level of granularity which are currently not possible with limited scale sensors that are deployed for collecting such data.

Using crowdsourcing to create content for mapping and their semantics has also gained interest. Sueda et al. [6] proposes a platform for crowdsourcing user generated content for knowing locations and addresses which may not be in the formal names of places on map by using geotagged Flickr images. Leveraging the mobile device's magnetometer and the accelerometer to crowdsource indoor map content of a building is discussed in [7]. The mCrowd [8] provides a platform to easily setup data collection experiments using mobile devices for different types of content.

The next breed of apps that are starting to appear and are most relevant to our work are the ones which help a peer community to collect data in natural sciences such as botany, zoology, ornithology, flora and fauna of a place, wildlife etc. [9] uses semantic

web technology to organize the metadata and establish cause-effect relationship between different species. It uses a Firefox plugin to crowdsource peer community data and tag observation of species in different locations. This data can then be used to understand what species can cause an un-observed effect to other species in the environment. A very recent interesting initiative by Indian Institute of Science named Pakshi [10] uses a location based mobile app to crowdsource data of different bird species and then shows it as a visualization on the map for the peer community to understand the sightings of different species at different locations.

Our work goes a step further than Pakshi which is primarily a crowdsourced data collection and visualization mechanism. EduBay is a mobile centric location based social learning platform. It provides following functionalities:

- Crowdsourced specimen data from peer-community using mobile sensors
- Location based data creation and visualization
- Connect the content creators and consumers for on-demand content creation
- Crowdsourced verification mechanism of data on EduBay platform
- Fair usage policy mechanism for content creation and content consumption for incentivizing new data creation.

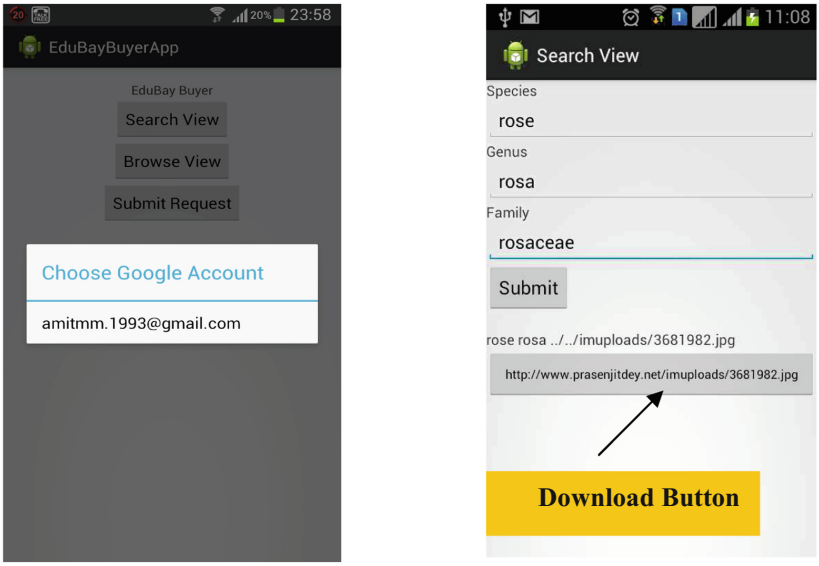
EduBay thus has a strong differentiation with respect to other platforms in terms of seamless integration of mobile device sensors for content creation, on-demand content creation for content that may be rare by connecting the creators and consumers (who need the content), crowdsourced verification mechanism to make sure the data is of good quality, and a fair usage policy mechanism to incentivize new content creation.

3 EduBay Client Applications

The EduBay platform consists of Android applications and a backend database server. In this section, we describe the features on the mobile client device. The user can create content in form of images, video and audio in the Android application and attach explicit meta-data along with the content. Some implicit metadata such as location (GPS), weather for the location, time of the year (date) etc. are captured automatically. The meta-data is stored in a MySQL database and the media (audio, video, ad images) is stored in a filestore, the pointer to which is stored in the database along with the meta-data. The application server is an Apache server. The architecture of the EduBay platform will be described in more detail in Sect. 4. We will now describe the different functionalities of EduBay that are delivered to the user through the Android application.

The Android application has two views:

- The Consumer Application: The EduBay Consumer app (will use app as short form for application hereon) delivers all the functionalities that are required by a user who is trying to get some content from EduBay. It provides functionalities such as search, browse, putting in a request etc. This part of the app will be described in more detail in Sect. 3.1.



(a) (b)

Fig. 1. Screenshots of the app showing (a) the app picking the email ID of the user from phone registry to track user operations; (b) search view to search with explicit meta-data.

- The Creator Application: The EduBay Creator app delivers all the functionalities that may be needed by a user trying to create some content for EduBay. It has tight integration with the mobile device camera to capture images, audio, video from the natural surroundings and immediately upload the content along with the metadata to the EduBay server. This part of the app will be described in more detail in Sect. 3.2.

When a user opens any of the views of the app, the app asks the user to confirm an email ID picked from the phone registry to attach an ID to the user. This is as shown in Fig. 1(a). This is useful in knowing which user created the content, verification of the content, and maintaining a fair usage policy for creation and consumption of content. These will be described in the following sections.

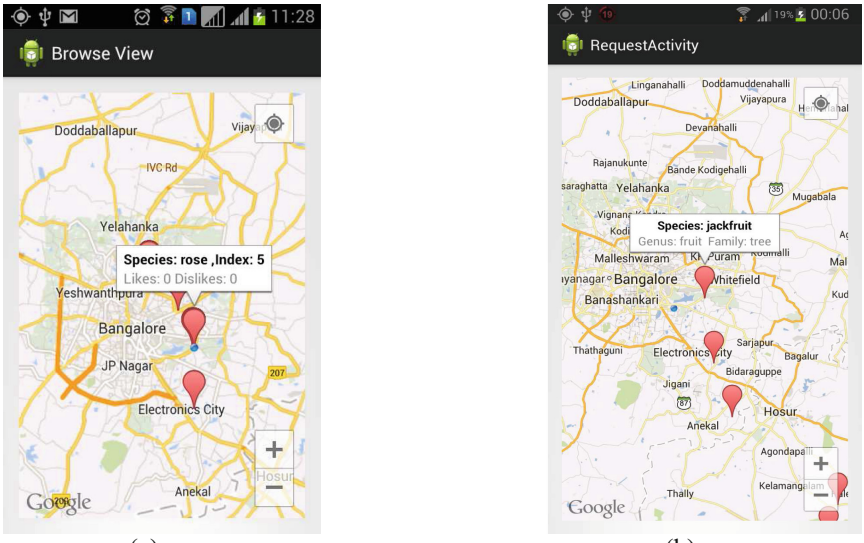
3.1 Consumer View

The consumer view of the app consists of three different functionalities. It allows the user to look for content in EduBay using explicit search or browse by location. If the user cannot find a content he/she is looking for, they can leave request for the content from a particular location on the EduBay platform. When creators from that particular location open their app they will see the request for content notification which they can fulfil. This is an unique location based feature of EduBay. When a user opens the consumer app, they see the following functionalities:

Search View: In this functionality, the user is presented with a form where they can fill-in the metadata details of the content they are looking for (if they know exactly the details of the content they are looking for) and search for the content. If they content is present in the EduBay platform, the user is presented with a link to download the content from the filestore. The user can click on those links and get the content on their mobile device. The view is as shown on Fig. 1(b).

Browse View: In this functionality, the user is presented with the content information present in the platform on a map. The user can quickly browse to a location where they think habitat of the content is and look for it. The user makes a "long-press" on the map location and all the content in vicinity of the location is fetched from EduBay. For example if someone is looking for a content about reindeer, they can directly browse to the Nordic region of the map and tap on that location and look for the content there. The view is as shown in Fig. 2(a). Once the content is found, the user can again tap on the information view markers and the content is downloaded on the device.

Request for Content: This is an unique feature of EduBay's location based services. If the user cannot find the content they are looking for, they can leave a request for other creators to get the content into the platform. The user can go to a location on the map from where they would like to get some content and "long-press" on the particular location. This opens up a meta-data form which the user can fill up and submit. Some of the meta-data such as the requester location, identity, etc. are prefilled. This content request with the metadata gets associated with the location and the users from that location can see it when they open the creator view of the app. They can choose to ignore or service the request. Once the request is fulfilled, the content goes to the main



(a) (b)

Fig. 2. Screenshots of the app showing (a) the view to browse artefacts by location; (b) request for content by location that are not found on EduBay are notified to creators of that location.

EduBay database and gets deleted from the content-request database. This unique feature can be very useful for content on the long-tail for which not many creators may upload content into EduBay. The view is shown in Fig. 2(b).

3.2 Creator View

The creator view of the app provides all the functionalities that are required by a content creator. This includes seamless use of the camera to capture audio, video, images with the app and upload it immediately to the EduBay platform. It also allows to see content-request notifications for the current user location. The consumer app has following functionalities:

Create Content: When the user presses on this button, it opens the camera of the mobile device with which the user can capture image, video, or audio. Once the user has finished the capture the app shows the capture and asks for a confirmation whether the user would like to discard and re-capture or accept the current capture. Once accepted, the media is sent to the file store and a random number string for the file name and the location is returned to the app. The user is then presented with a form where they can fill up the content metadata. Implicit meta-data such as GPS location, and filestore media location, user identity (available from initial authentication as described above) are automatically filled. The user submits the form and the data is stored in the EduBay server. The app view is as shown in Fig. 3.

Service a Request for Content: In this functionality the user can see all the current request-for-content for the present creator location on a map as described in Sect. 3.1. The user can browse through the requests and if they would like to fulfil some request, they can tap on the marker which open up the camera and the user can follow the same steps as described in the content creation functionality above. The view is as shown in Fig. 4. Once the request is fulfilled, it is removed from request database and put in the main EduBay database, and the marker on the map disappears from the request notifications.

3.3 Crowdsourced Verification

The content that is created may not be always be of good quality. In EduBay platform we provide a way for the peer community to vote for the quality of the content. When a content is created, it is always available for viewing or download by the users from the Consumer View of the app. When users download a content, they are presented with a view of the content and its meta-data. The user has a way to vote “Like” and “Dislike” for the content. If a content receives more than 10 dislikes, the content is removed from the EduBay platform. In order to have a fair verification of the content, if a user tries to vote for his/her own uploaded content, the vote does not get counted. The identity of the user who is voting is established from the embedded identity of the user in the app which was given by the user when the app was first used, as was described earlier. A screenshot of the voting screen is as shown in Fig. 5.

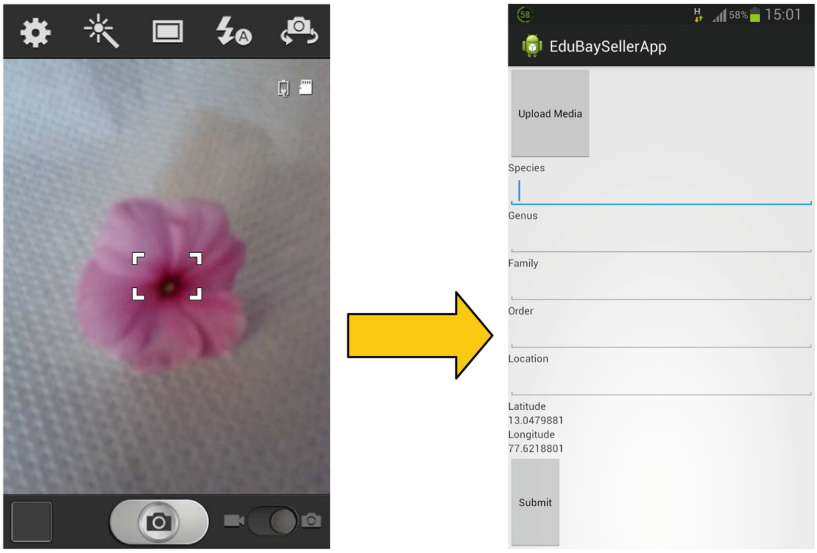


Fig. 3. Screenshots showing the process of capture of media and the entry of explicit meta-data to the media. Note that implicit meta-data such geo-location has been automatically filled once the media is captured.

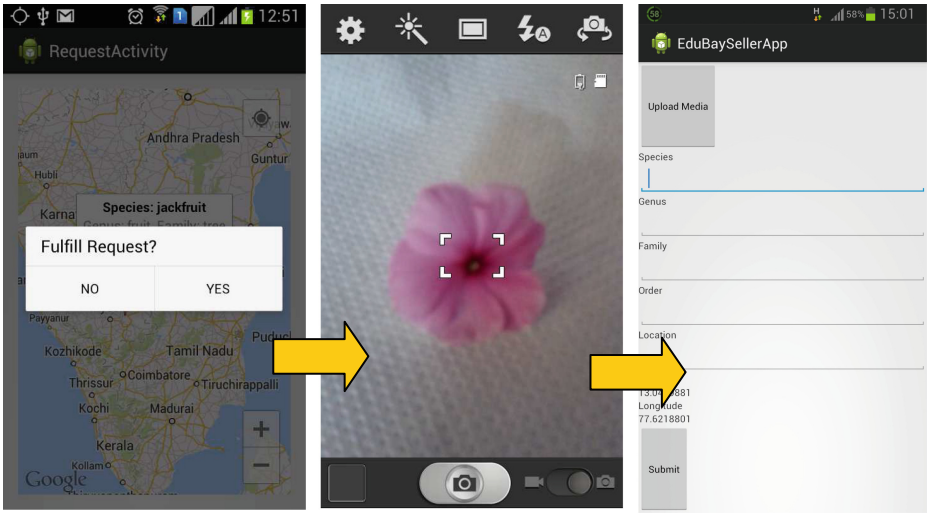


Fig. 4. Screenshots showing the process of fulfilling a content request. The content creator agrees to fulfil request from their current location which when accepted opens the camera and then bring up the form to attach explicit meta-data. As before implicit meta-data is automatically filled.

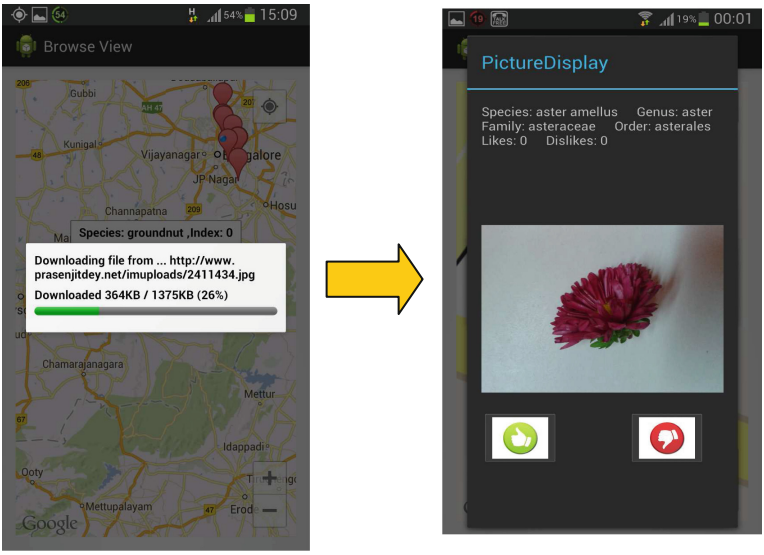


Fig. 5. Screenshots showing the crowdsourced verification process in EduBay. When the media is downloaded by a user they can "like" or "dislike" a content. A content with too many dislikes is purged from the system.

3.4 Fair Usage Policy

To ensure that the users of EduBay have incentive to upload good content into the system, we keep an account of each upload and download by a user. If a user only consumes data from EduBay and never contributes to it, we do not allow the user to download any more media. We block the download of the media until such time the user has uploaded some media into EduBay and the ratio of upload and download has reached a particular threshold. We also keep track of the quality of content uploaded by a user. If the content of a user is consistently "disliked" and purged from the system, we block the user for a particular period of time from participating in the EduBay system.

4 EduBay Server Architecture

The EduBay system architecture is as described in Fig. 6. The system consists of the client platform which in our case is an Android device. The backend EduBay Server is an Apache server running PHP scripts. All the communication between the client and EduBay server is using HTTP. The EduBay backend consists of three databases and one media store. All the databases are MySQL databases and the Media Store is a flat file server. The components are:

- *EduBay Meta-Data DB:* This is the main database which store all the media meta-data created by the user and also the implicit metadata such as location, time, user, media file location etc.

- *Content Request DB:* This stores the content-requests as described in Sect. 3.1. Once a request is fulfilled, the particular entry is removed from the database and transferred to the EduBay Meta-Data DB.
- *User Account DB:* This stores all the details about each user such as number of uploads and downloads, number of purged data due from the system due to dislikes etc.
- *Media Store:* This stores all the media files such as images, audio, video, or any other file. When file is uploaded into the Media Store, the original name is removed and a seven digit random number generated name is attached to it to avoid name clashes. This name is then passed to as reference in the main EduBay meta-data database.

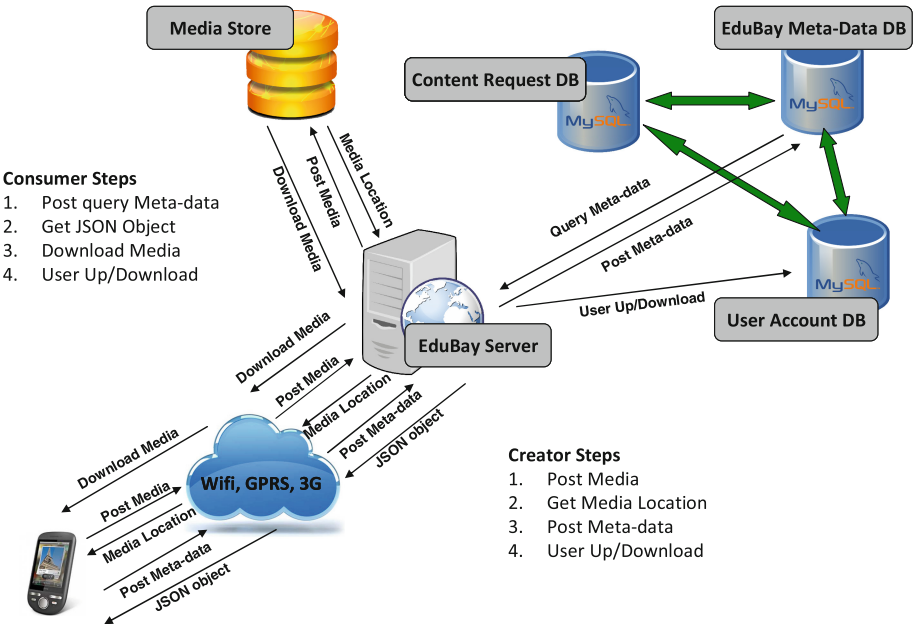


Fig. 6. The EduBay architecture where the creator and the consumer have different steps to follow for interacting with EduBay platform.

When a *creator* captures a media and wants to transfer it to EduBay, the Android application first transfers the media file to the Media Store and receives a seven digit random number generated name for the file and its location. The user then fills up the explicit meta-data form as described in Sect. 3.2. The implicit metadata such as location, media store location, time, user identity etc. gets automatically filled. The meta-data is then posted to EduBay server which is then transferred to the EduBay Meta-Data DB. The User Account DB also gets updated since the user has uploaded some content.

When a consumer wants to get some media from EduBay, the user goes to the search view or browse view of the EduBay Consumer Android App. When the user

selects an artefact, meta-data of the artefact is posted to the EduBay server and the media location is queried from the EduBay Meta-Data DB. The Android App then uses the returned location of the Media Store and downloads the media from the Media Store. The User Account DB is also updated to reflect the download done by the user. If the user does not find some content in EduBay they can place a request for content as described in Sect. 3.1. These requests are stored in Content Request DB. When a request has been serviced by a creator, that request is removed from the content request database and the metadata and the media is transferred to the EduBay Meta-Data DB and Media Store respectively, just like any other created media content.

5 Conclusion

This paper presented a simple mechanism to enable creation, verification, browsing, searching and requesting of content through mobile devices. The platform exploits the fact that it uses the mobile device to capture content, thereby automatically adding location and weather type of meta-data information to tag along with the content. It then targets the platform to scenarios where content such as pictures and location is important, which leads to its application in the natural science stream. The content creation, verification and content search applications on the mobile device are simple enough for a novice mobile user to access its features. The ability to host the content on the centralized server enables possibilities of scalability, additional processing and faster response times for each user request. Allowing a user to request and search for content based on location is definitely a novel and important problem in the education space, especially for natural sciences subjects. With more and more of education content getting online and social, through the various Massive Online Open Courses (MOOC), the EduBay platform can be a timely and novel solution in the space of content creation and sharing.

6 Discussion and Next Steps

We believe EduBay to be a timely solution both from a point of view of the way Online Education is shaping up, and from the possibilities that now arise from the rich mobile devices. Recent work in online education has focused more on the content delivery [11, 12] than on content creation, whereas content creation has been identified as a real challenge in this space [13]. EduBay therefore can fit in as a strong platform to improve content creation in this changing space of education. It paves a new path for creating content through mobile devices – which have so far been restricted mostly for content consumption, especially in the education space.

Going forward, we plan to do pilots in two universities, which are geographically separated but have the same course curriculum, i.e. a university in Finland and India, on a course in natural science or agriculture department. By providing EduBay to students and teachers in this pilot, we hope to attract the usage of the system and determine its effectiveness in a real course. From a technical perspective, we plan to augment the data collected by deriving more meta-data from the content to enable

richer search and browsing of this content. We would like to understand more in-depth how conflicts can be resolved and quality control can be done when content is created collaboratively. There are other multiple technical challenges in building such a system which we would like to study in our future work. These include higher level inferred metadata creation, multiple updates strategy, incremental update in metadata, schema evolution, etc. We also plan to extend EduBay for scenarios where it may not be restricted just to natural science subjects but also to collaboratively create any content that can be useful in the education context.

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