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Educational Potential of Map Storytelling Creation using Data Objects-Driven Mobile Mapping Toolkit – KoPpoMai

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Abstract:

With the spread of mobile devices and the advances of computational techniques on geo-referenced data, location-based services (LBSs) have offered many benefits, such as searching neighbour spots and navigations, as one of the significant domains of computer science. Our research aims to establish a learning toolkit and its educational practice on LBSs for the realisation of STEAM in the field of cartography. STEAM, a new educational interest, refers to the importance of science, technology, engineering, the arts, and mathematics through creative activities. The authors have conducted a class at Akita University in Japan, which was set for junior university students majoring in computer science. Most students were considered to have little background knowledge of cartography and geographic information systems. Considering that STEAM education should inspire students' creativity in their learning, the class has assigned group work aiming to understand theories and implementations of basic LBSs through map storytelling creation. Specifically, students prepare illustrated maps and points of interest (POIs) with a theme, combine geo-referenced data with mobile LBSs to represent their stories dynamically, and demonstrate the user experiences of the services. Through mobile learning, students can obtain an opportunity to check how their services work in the real world and present their map stories to others, which leads to exploring technical issues of LBSs from the viewpoints of application users and software engineers.

Unlike the previous educational practice of map storytelling creation, which was not for computer science students (Lu et al. 2016), the class prepared new style development environments for more professional STEAM education – the data object-driven mobile mapping learning (DODMML). The concept diagram is shown in Figure 1. In the DODMML, students implement their LBSs by defining static values to JavaScript object notation (JSON)-formatted files. Today, JSON is widely used to exchange data among internet services and is known as one of the simplest and most lightweight data definition formats. A data object in the DODMML denotes a set of parameters that defines a specific LBS function. Students edit several data object files and let KoPpoMai, an iOS application we have developed, load them to review their map storytelling. The development environments were expected to enhance students' practical learning from two perspectives. First, the DODMML would make students aware of a mathematical model of LBSs in implementing their ideas on a data object. As KoPpoMai executes built-in algorithms of LBSs based on data objects, students need not to code the logic of user interfaces and computational processing by themselves but to turn parameters after understanding the concepts and data types. For most undergraduate computer science students, the low-coding environments could expedite their skills and confidence in software development. Second, the DODMML makes the editing process of storytelling application-independent – thus, students can develop their work remotely and collaboratively via the internet. In our class, we introduced GitHub, which is one of the most famous cloud-based source code hosting services, for tracking their changes in source files and visually coordinating collaborative developments. It also may be feasible to visualise the degrees of students' engagement in their group work based on records of GitHub's change tracking.

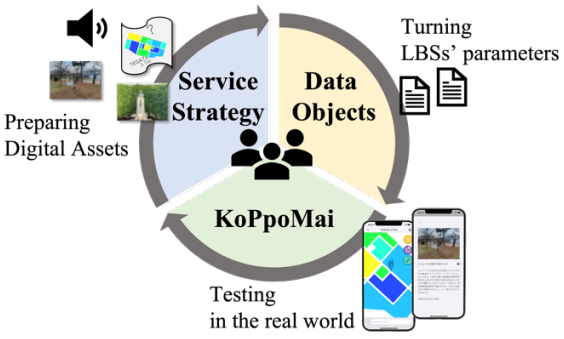

Figure 1. Concept diagram of the data object-driven mobile learning

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In the current version of KoPpoMai, students can realise LBS functions using three kinds of data object files with original structures.

(1) *georeferencing.json*: Base maps are also considered to be one of the important components for storytelling. KoPpoMai transforms geographic coordinate values into image coordinates values by similarity triangles using predefined control points and enables integrating illustrated maps with LBSs. In the data object file, students determine more than two pairs of image coordinate and geographic coordinate values in an array (Figure 2).

(2) *geofencing.json*: Students place POIs on the base map and connect them with multimedia content such as texts for description, an image, and audio to present stories about each POI. In addition, KoPpoMai provides push services (geofencing) based on circular geofences of POIs. When a user enters the geofence, KoPpoMai starts to blink an icon of the POI and plays the audio automatically. In a data object, students write a location where they want to put a POI, the radius for geofencing, and its description. As for other multimedia content, an image and an audio file are named the id number of the POI (Figure 3).

(3) *trajectory.json*: Students simulate a user's movement by describing a set of reference points of a walking trajectory in the file. GeoJSON, an open standard format to encode geographic data structures based on JSON (IETF 2016), is supported to define a trajectory in KoPpoMai. Additionally, this data object file would be automatically generated while walking in the real world with the application. Students can make demo videos based on the actual movement of walkers in their presentation.

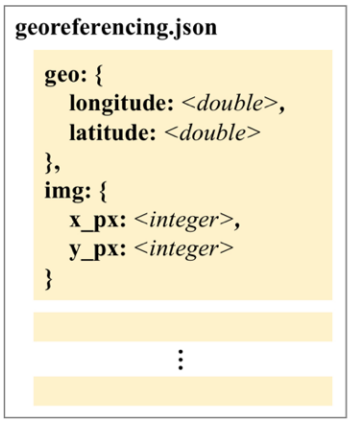

Figure 2: Structures of georeferencing.json

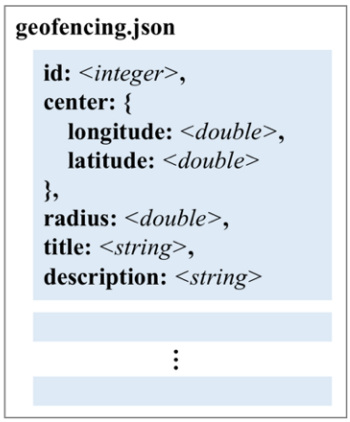

Figure 3: Structures of geofencing.json

The class was held for three weeks and 135 minutes each week. In advance, students were divided into 18 teams – each team had two or three students. The first week aims to lecture on the basic LBS mechanisms, the development using KoPpoMai, and team programming with GitHub. The second week is fully used for group work. At last, students give presentations on their map storytelling on the third week. As a result of the class, we considered that all students were able to extend their understanding of LBSs because they had successfully created their work using all kinds of data object files. The final presentations showed us particularly three examples of types of map storytelling using KoPpoMai: (1) Functionality – offering lexical information to make users' life convenient, e.g., parking lot maps and amusement arcade maps; (2) Public relations – providing tour guides with an interesting theme in students' hometown, e.g., historical sites maps and maps introducing real-life anime locations; (3) Virtualisation – linking a familiar place with the other places that are far away in time or space (sometimes not exist on the earth), e.g., overlaying a layout of the international space station on a university campus. Based on their trials and errors, KoPpoMai needs to extend variations of data objects, for example, visualisation of recommended routes. Furthermore, the DODMML has encouraged students to collaborate with other team members on mobile mapping developments. Teachers can check how many times each team has committed changes of data object files via the internet on GitHub. This would be a feasible way of visualising students' involvement in group work and the details of their learning process. Interestingly, the file hosting service seemed to enable some teams to divide roles, i.e., editing data objects and testing LBSs' work using an iPhone, and then derive deeper group communications for identifying their problems.

References

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