RS-FUN FOR SHARING EDUCATIONAL MATERIALS ON REMOTE SENSING

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ABSTRACT:

The authors are developing educational material package for remote sensing called RS-fun with Macromedia Flash software. RS-fun is developed under the concept of "edutainment"(education + entertainment). RS-fun is a kind of Q&A game on the Web. Users can learn about the basic concept of remote sensing with some fun. In this study we propose a procedure for developing and sharing RS-fun with other scientists and educators. Four international teams are planed to be set up for developing and sharing RS-fun. The four teams are Development Team(Team-D) , Scenario Team(Team-S), Evaluation Team(Team-E), and Translation Team(Team-T). Team-D develops modules of RS-fun by using Macromedia Flash. Team-S produces scenarios and/or images to be used in making new modules. Team-E evaluates scenarios and produced materials, and makes suggestions to Team-S or Team-D if necessary. Team-T translates the texts of completed RS-fun package to various languages if needed. The educational material developed in this framework will be open to public through web. The international framework of RS-fun may expand the possibility of developing educational software for remote sensing.

1. INTRODUCTION

1.1 Types of educational materials on Internet

Nowadays, various universities, research institutions etc. are developing educational materials on remote sensing. Many of them are open to public via Internet. Those materials can be classified into four types. The first type is textbook type material. "Remote Sensing Tutorial" of NASA/GSFC(Nicholas Short, 2006) and "Fundamentals of Remote Sensing" of CCRS(2006) are good examples of the textbook type material. The beginners can learn about remote sensing like reading a book. The hypertext function is one of the advantages of this type of material. The second type is power point/slide type material. Not a few university professors are uploading their power point type teaching materials on their web site to support their students, and some of them are also open to public. Though user can not expect detailed explanation in slide type materials, visualized figures and compact explanations are sometimes much understandable than detailed explanation. The Department of Geomatics at the University of Melbourne is providing many good lecture slides on remote sensing at their web site for the students to down load(2002). The third type is lesson plan type material. "An Introduction to Remote Sensing" of Science NetLinks(2002) is a good example. This type of material is mainly prepared to help teachers to learn how to teach remote sensing to their students. The fourth type is interactive game type material. Graphical and interactive operations are realized in this type of materials using Java and/or Macromedia flash technologies. "What on Earth" of NASA(2003) is an good example. Like playing a game, user can learn about remote sensing with some fun. The RS-fun(Cho, 2004) described in this paper is categorized in this type of material.

1.2 Proposal

So, various kinds of educational materials on remote sensing are on the Internet. However, since most of them are developed independently, the concept, target users, and levels of them are quite different from each other. The themes and items covered with each educational material are also limited. In order to share know how, experiences, and ideas of making good educational materials on remote sensing among international scientists and educators, setting up of some procedure or framework for cooperation is necessary.

Among the above four types of educational materials on Internet, the interactive game type materials have strong advantages against traditional educational materials. However, since the development of this type of material takes time, the number of the materials of this type for remote sensing is still limited. The authors have been developing interactive educational material for remote sensing called RS-fun with Macromedia Flash software. RS-fun is a kind of Q&A game on the Web, and allows users to learn about the basic concept of remote sensing with some fun. In this paper, the procedure for developing and sharing RS-fun for remote sensing education is proposed.

2. RS-FUN

2.1 Developing Concept

The target users of RS-fun are beginners of remote sensing, including high school or lower grade students who do not know much about remote sensing. In order to interest high school or lower grade school students, the authors decided to introduce

the concept of "edutainment: education and entertainment" for developing a new educational material on the Internet. But, this does not mean RS-fun is for kids. The interactive operation does not only interests students but also allow them to check the level of their understanding.

2.2 System Configuration

RS-fun is a software package installed on a web server to allow users to access via Internet with web browsers. Macromedia Flash is used as the authoring tool to provide interactive operations with various visual effects to make users feel more like playing computer games. In order to utilize Flash functions, users have to install free software Flash player to their browsers before using RS-fun. RS-fun mainly consists of three modules which are Q&A Module, Jigsaw puzzle Module and Database Module (see Figure 1).

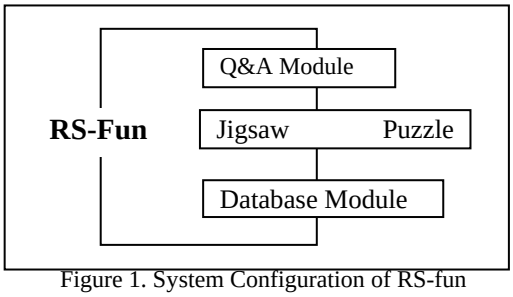
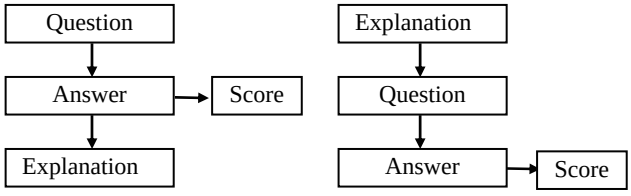


Figure 1. System Configuration of RS-fun

2.3 Q&A Module

2.3.1 Basic Procedure of Q&A

In the Q&A type educational materials, there are mainly two procedures as shown on Figure 2. One is "Explanation-after-Q&A" and the other is "Explanation-before-Q&A".
In the "Explanation-after-Q&A" procedure, some questions on a certain topic are asked first, and then answer and explanation about the concept will be followed. In this procedure, question will raise user's curiosity about the topic and motivation to read the explanation will be increased. But, on the other hand, the score of the Q&A does not reflect the level of their study achievement.



(a) Explanation-after-Q&A (b) Explanation-before-Q&A

Figure 2. Procedure of Q&A

In the "Explanation-before-Q&A" procedure, the concept of a certain topic such as "reflectance" is explained first, and then questions about the topic will be asked. Since the answer of the question is usually included in the explanation, the user can check their understanding about the explanation of the topic, and the score of the result will reflect the level of their study achievement. But, on the other hand, in this procedure, users sometimes have to read the explanation without their interest on the topic.
Since RS-fun is prepared for the beginners who are interested in remote sensing, we decided to mainly use the former procedure.

2.3.2 Operational Procedure of Q&A Module

Figure 3 shows the operation procedure of Q&A Module. The Q&A Module consists of a series of sessions. Each session deals with one particular topic on remote sensing such as "Spectral reflectance" or "False color composite". At first, a user selects a session and starts reading the text explaining the topic of the session. Figure 4 shows an example. In the top of this session, concept of remote sensing is explained (See Figure 4(a)). After reading the explanation, users have to do an exercise. In this case, the user has to select a right answer from the three alternatives. According to the user's answer, the message "WRONG!" or "CORRECT!" would be displayed on the screen as shown on Figure 4(b) and (c). If the answer was wrong, the user can read the explanation and try the exercise again if he/her wanted. In this way the user can check his/her understanding of the session. After finishing one session, user can move on to the following sessions one by one.

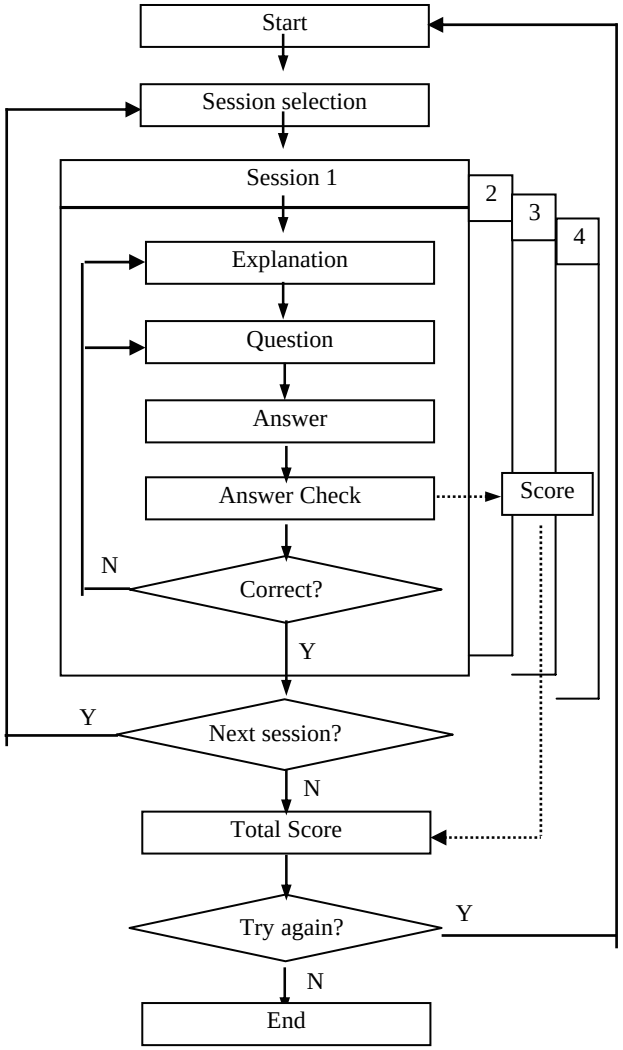
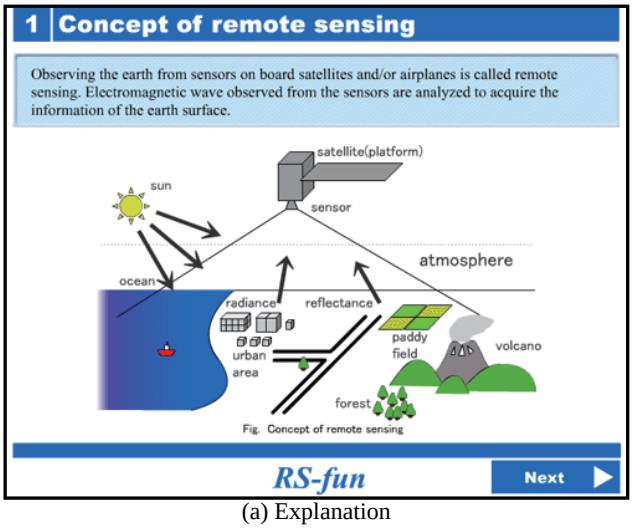
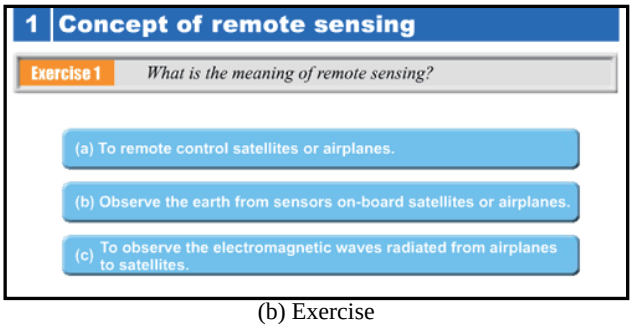


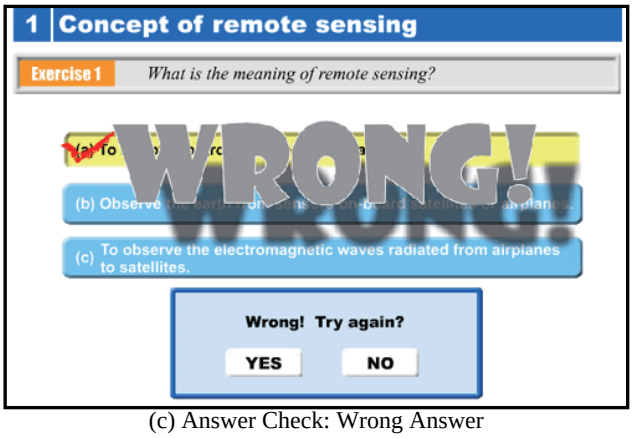
Figure 3, Operation Procedure of Q&A Module



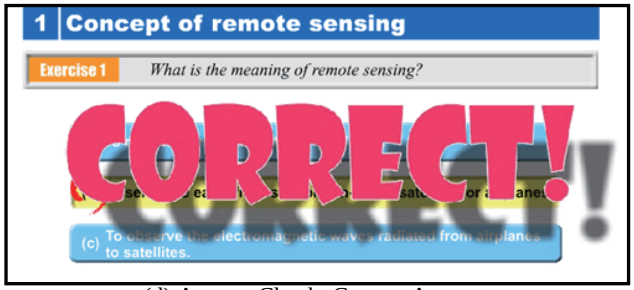
(a) Explanation



(b) Exercise



(c) Answer Check: Wrong Answer



(d) Answer Check: Correct Answer

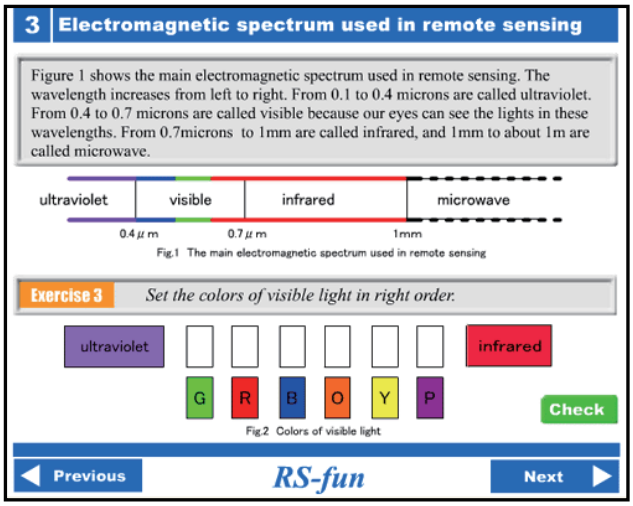
Figure 4. Graphical operation examples of Q&A Module.

2.3.3 Unique Features

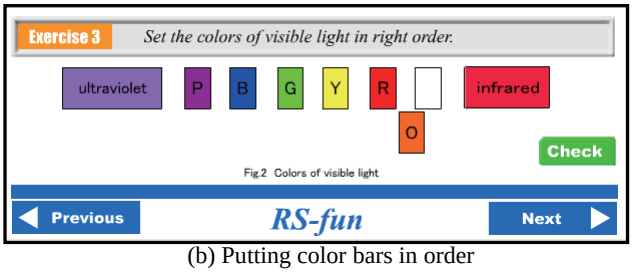
In order to make Q&A Modules attractive to users, several unique features are considered when composing each material of RS-fun.

(1) Graphical Operation

As shown on Figure 4, the multiple choice exercise is one of the most common types of exercises used in these kinds of interactive educational materials. However, this type of exercise does not have big difference with traditional textbook exercises. In RS-fun, graphical operations are enhanced to attract users. Figure 5 shows such an example. This session explains about electromagnetic spectrum used in remote sensing. In the exercise, a user has to move the color bars in right order. Since user can freely move or swap each color bars, the user feel more like playing a game than doing an exercise.



(a) Explanation and exercise

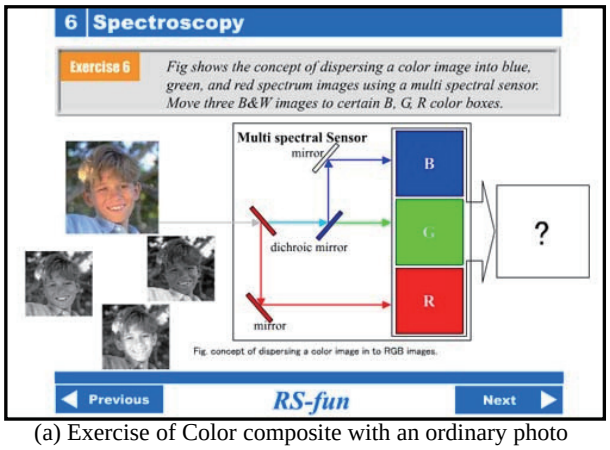


(b) Putting color bars in order

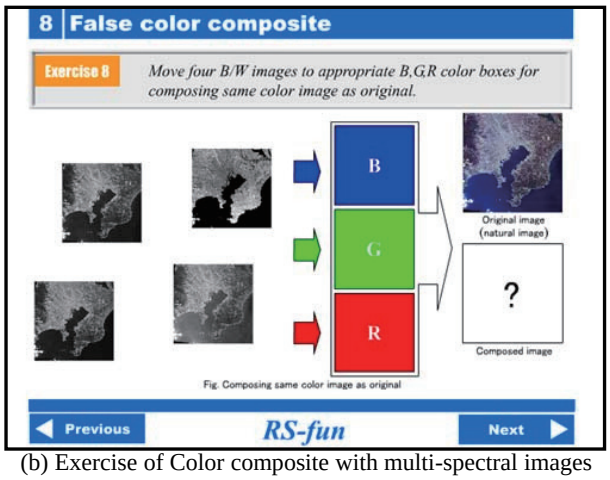
Figure 5. Graphical Operation example used in exercises.

(2) Simplification and materialization

For explaining certain concept, simplification is quite useful. However, once the concept is understood, it is very important to learn more about the reality. Figure 5 shows such an example. Color composite is one of the most basic and important techniques one has to learn in remote sensing. However, understanding the meaning of color composite using remotely sensed multi-spectral images is not easy. In RS-fun, a photo of a boy is used to understand the concept of RGB color composite(See Figure 6(a)). If each image is not set in right order, the composite color image of the boy does not become same as the original. This is much understandable than using satellite images. However, once the concept is understood, the user moves to the next step where false color composite images are produced from multi-spectral images (See Figure 6(b)). Because of the graphical operation, users are more likely to enjoy answering to each question.



(a) Exercise of Color composite with an ordinary photo



(b) Exercise of Color composite with multi-spectral images

Figure 6. Simplification and materialization

(3) Score

According to the user's answer, the message "CORRECT!" or "WRONG!" pops up on the screen as shown on Fig. 3. This flashy action gives users strong motivation for answering correctly. Each time user answers a right answer to each questions, one point is given to the user. When the user comes to the end of the sessions, the total score will be displayed on the screen (see Figure 7). Like a game, the score will be a good motivation for trying RS-fun again to improve his/her understanding of remote sensing

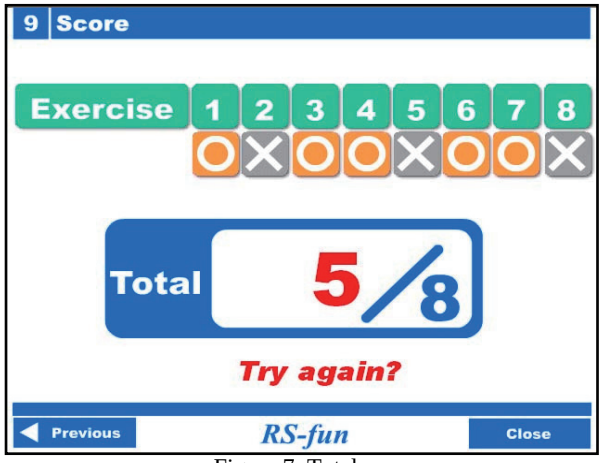


Figure 7. Total score

2.4 Jigsaw Puzzle Module

The Jigsaw Puzzle Module contains a series of digital jigsaw puzzle of satellite images such as of Landsat/TM, JERS-1/SAR, Terra/MODIS, IKONOS. The jigsaw puzzles are not prepared only for fun but also to give good chance for the beginners to carefully look at satellite images.

2.4.1 Operation Procedure

Figure 8 shows a jigsaw puzzle of MODIS image of the sea ice area of the Okhotsk Sea. When a user starts to "play" the puzzle, the satellite image is divided in to 5 x 5pieces and shuffled. The user has to move each piece to right place to re-construct the original image. By pushing the NAVI button, the original image is displayed in light colors, which help the user to find the right place to put each piece.

2.4.2 Unique Features

(1) Timekeeping

In order to make user's satisfaction, the lapsed time is displayed in the bottom of the jigsaw puzzle (see Figure 8). This will force users to try again and again to improve their time for completion. Through several times of trials, users are likely to be used to the satellite image and recognize the detailed patterns of the image with some enjoyment.

(2) Data base linkage

Satellite and sensor names displayed in the jigsaw puzzle screen are hyper linked to the Database Module (see next session). When users click the name of the satellite or sensor placed next to the puzzle image, the detailed information will be displayed on the screen. These information help users to understand about the specifications of the satellite and the sensor of the image.

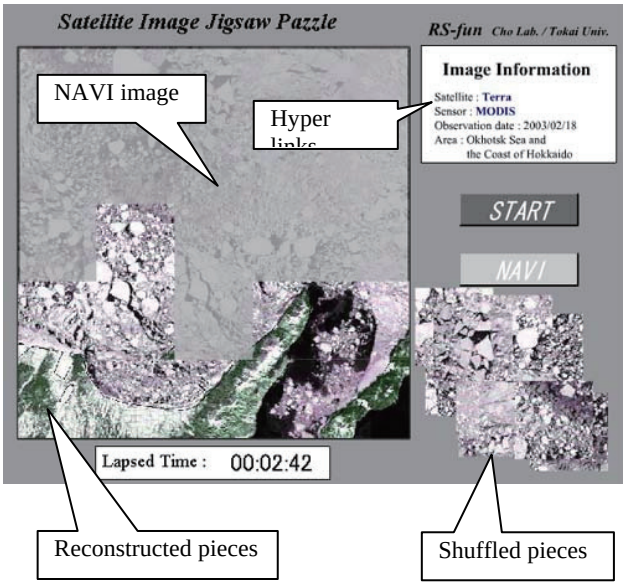


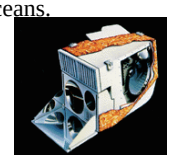
Figure 8. Jigsaw puzzle of MODIS image of sea ice area

2.5 Database Module

Database Module consists of various information related to remote sensing. Important key words such as “electromagnetic wave”, “satellite”, and “platform” in the Q&A Module as well as in the Jigsaw Puzzle Module are hyper linked to the database Module, so the user can learn more details on certain subject. Figure 9 shows a part of the MODIS sensor information stored in the Database Module. We plan to expand the database from time to time.

MODIS（Moderate Resolution Imaging Spectrometer）

[Outline]
MODIS is a 36-band multi-spectral radiometer aboard the Terra and Aqua satellites of NASA. MODIS data are being used to derive products ranging from vegetation, land surface cover, and ocean chlorophyll fluorescence to cloud and aerosol properties, fire occurrence, snow cover on the land, and sea ice cover on the oceans.



[Sensor Specifications]
Satellite : Terra, Aqua
Orbit : Sun synchronous,
Altitude:705km,
Equator crossing time: 10:30AM(Terra), 1:30 PM(Aqua)
Swath : 2,330km
Spatial resolution :
250m (Wavelength : 0.620 - 0.876μm, Band:1-2)
500m (Wavelength : 0.459 - 2.155μm, Band:3-7)
1,000m (Wavelength : 0.405 - 14.385μm, Band:8-36)
Planned lifetime: six years

< Related Links >
NASA(MODIS Web) :
http://modis.gsfc.nasa.gov/about/specs.html
MODIS reception at Tokai University :
http://www.tric.u-tokai.ac.jp/rsite/r1/modis/modis.html

Figure 9. Information example stored in the DataBase Module

3. PROCEDURE FOR SHARING EDUCATIONAL MATERIALS

So far, the concept of RS-fun is well accepted by the user community. However, RS-fun is still a small package for education. In order to share know how, experiences, and ideas of making good educational materials on remote sensing among international scientists and educators, setting up of some procedure or framework for cooperation is necessary. The authors would like to propose the following procedure for developing and sharing RS-fun with other scientists and educators.

3.1 Setting up of Teams

Total of four teams are planed to be set up for developing and sharing RS-fun. The four teams are Development Team (Team-D) , Scenario Team (Team-S), Evaluation Team (Team-E), and Translation Team (Team-T). Team-D members have the ability to develop some sessions of Q&A Modules of RS-fun by themselves using Macromedia Flash. Team-S members do not develop sessions by themselves, but produce scenarios and/or images to be used in making new sessions. Since good scenario is the key for making a good educational material, this team needs experienced educators and scientists from various application fields. Team-E members evaluate scenarios and produced materials, and make suggestions to Team-S or Team-D if necessary. So far, the texts of RS-fun are prepared in English and in Japanese. Team-T translates the original RS-fun to certain language. Figure 10 shows the relationship of the four teams and users. To keep the quality and concept of RS-fun, Team-E finally decides to include a new material to RS-fun or not. Members of each team are not concrete, and can belong to plural numbers of teams.

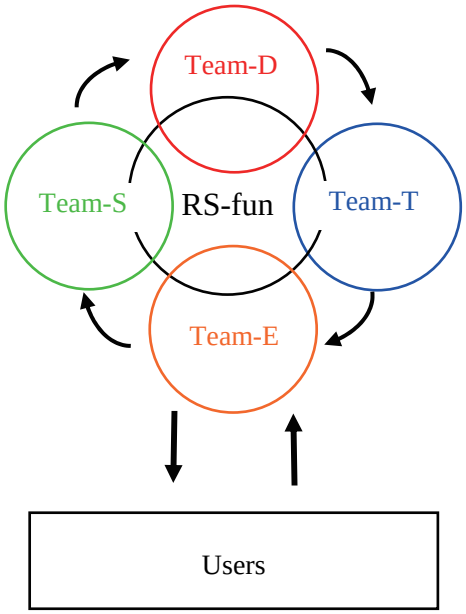


Figure 10. Relationships of Teams for RS-fun development

3.2 Development procedure

(1) Q&A Module

Firstly, Team-S produces certain scenarios of new sessions. The scenarios are reviewed by Team-E, and some modification to the scenarios will be applied by Team-S or Team-E if necessary. The information on important keywords will also be collected. When scenarios are ready, Team-D starts to develop actual sessions. The developed sessions are reviewed by Team-E, and feedback goes to Team-D for improvement. The prototype of a session of Q&A module will be provided to the team members. So, if a member has Macromedia Flash software, one can develop a new session of RS-fun by one’s self. The authors are planning to modularise each session so that teachers can sort out sessions and decide the order of sessions according his/her lecture plan.

(2) Jigsaw Puzzle Module

Team-S collects certain remote sensing images and additional information on the images for jigsaw puzzle production. The information should include image explanation, map, name and specification of platform/sensor. Since the authors have developed software for making jigsaw puzzle from an original image, the making of jigsaw puzzle itself is quite simple and automatic. Team-D will make the jigsaw puzzle after receiving images and related information from Team-S.

(3) Database Module

After accepting scenarios and information on jigsaw puzzle images from Team-S, Team-D starts to produce data base files in html format. Those files are linked from Q&A Module and/or Jigsaw Puzzle Module.

3.3 Dissemination

After the evaluation by Team-E, the new materials are added to previous RS-fun on the web server to allow users to access via Internet. The initial version of RS-fun is accessible at the following site
http://www.yc.ycc.u-tokai.ac.jp/ns/cholab/RS-fun/index.html.
The copy of the products will also be provided off line to the team members according to their request.

3.4 Copyright

All the contributors will be clearly indicated on the web site of RS-fun. In general, the copyrights of the materials remain to RS-fun team. However, for particular images or graphs etc., the copyright may remain to the person or organization that provided them.

4. Conclusion

The concept of a remote sensing education software package RS-fun was explained in details in this paper. The interactive operation of RS-fun allows beginners including high school or lower grade students to learn about remote sensing with some fun. In order to expand the role of RS-fun, procedures for developing and sharing RS-fun with other scientists and educators were proposed in this paper. We already have received intentions from several scientists. For example, Dr. Sultan Hasan AlSultan of Qassim University of Saudi Arabia has started to translate RS-fun texts into Arabic. The authors are pleased to cooperate with those who are interested in developing, improving, and using RS-fun for education.

Acknowledgment

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References

Short N., 2006, Remote Sensing Tutorial (RST), NASA/ GSFC, http://rst.gsfc.nasa.gov/

CCRS, 2006, Fundamentals of Remote Sensing, http://www.ccrs.nrcan.gc.ca/ccrs/learn/tutorials/fundam/fundam_e.html

Williamson I., 2002, Remote Sensing Lecture Materials, University of Melbourne, http://www.geom.unimelb.edu.au/

AAAS / Science NetLinks, 2002, An Introduction to Remote Sensing, http://www.sciencenetlinks.com/matrix.cfm

NASA, 2003, What on Earth, http://kids.earth.nasa.gov/games/

Cho K., R. Matsuoka, H. Shimoda, Y. Matsumae, 2004, RS-FUN: A Web Based Interactive Learning Package for Remote Sensing Education, Proceedings of the 25th Asian Conference on Remote Sensing, P-721-726.