Educational Java Games for Electroplaters

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Several Java game programs in the public domain were modified to create: (1) a puzzle game in which nameplates of metal elements are to be rearranged in the order of ionization tendency; (2) a memory game in which the combinations of "Ni and Watt bath", "Cr and Sergent bath" or "Zn and Zincate bath" are to be selected; and (3) a slot machine game in which images of Faraday, Volta, Galvany and so on, are rotated.

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1. Introduction

Many game softwares programmed by Java applets are in the public domain on the Internet. The authors modified these programs, and created useful Java games for educating beginners in metal surface finishing technologies. Animations in the field of chemistry using Java applets are also introduced in this report. At the end of the paper, new idea of “Digital Potential-pH Diagram” is introduced.

2. JAVA games for educating beginners

2.1 Modification of the JAVA puzzle game

Figure 1 shows a standard Java puzzle game by a Japanese man. A puzzle game is a game in which a character or figure is divided into several parts within a rectangular frame and arranged at random These parts are to be arranged in the correct order to display the completed character or figure. If these characters or figures are replaced by those related electrochemistry or surface finishing technology, the puzzle becomes a useful game for educating beginners of metal surface finishing technologies.

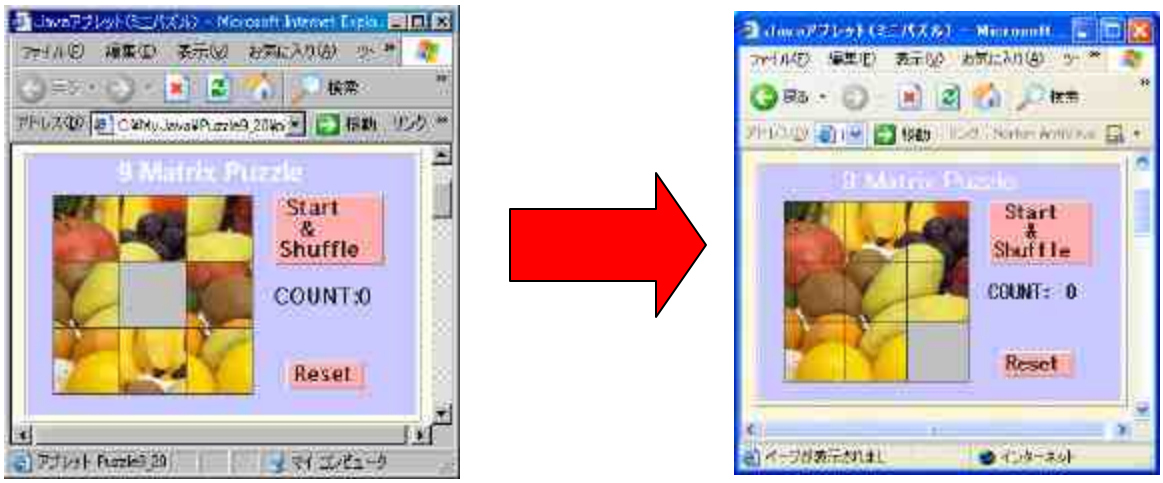

Fig 1 Standard Java puzzle game

Fig 2 shows a puzzle game in which symbols of metallic elements are to be arranged in the order of "ionization tendency". The panels of metallic element signs arranged at random are to be moved one by one (Figure 2(A)). When these panels are correctly displayed, the characters "Good" and the frequency with which the panels are moved to arrange them correctly are displayed on the game screen (Figure 2(B)). A beginner of metal surface finishing technology playing the game many times can learn the "ionization tendency" of metals.

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(A) Start screen (B) Game end screen

Fig. 2 Puzzle game in which symbols of metallic elements are arranged in the order of "Ionization tendency"

Fig.3 shows a puzzle game in which nameplates of unit processes of aluminum surface line are to be arranged in the correct order. The game is completed when eight panels are displayed in the following order: "Buffing", "Racking", "Degreasing", "Etching", "Anodizing", "Dyeing", "Sealing" and "Detach from the rack."

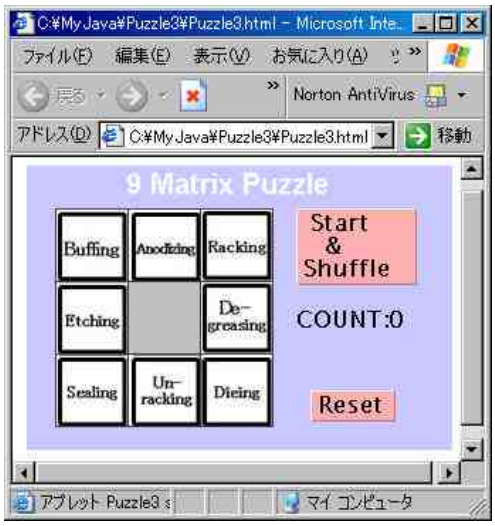

Fig. 3 Puzzle game in which nameplates of unit processes in aluminum the name of surface treating tanks surface processing are to be arranged in the correct order

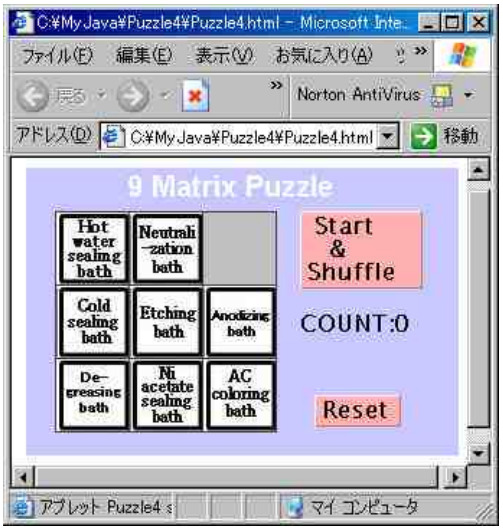

Fig. 4 Puzzle game ordering

A little advanced knowledge of aluminum surface finishing technology is necessary to play the game shown in Fig 4. There are eight panels having the names of surface treatment tanks: "Pure water sealing bath", "Etching bath", "Anodizing bath", "Degreasing bath", "Nickel acetate sealing

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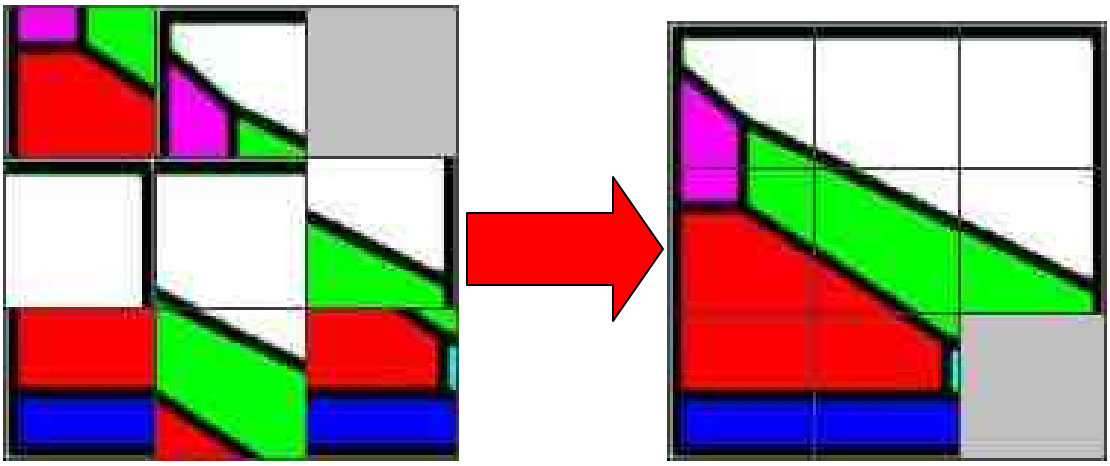
bath", "Cold sealing bath", "Electrolytic coloring bath", and "Neutralizing bath". The game is completed when these eight panels are arranged in the descending order of bath temperatures.

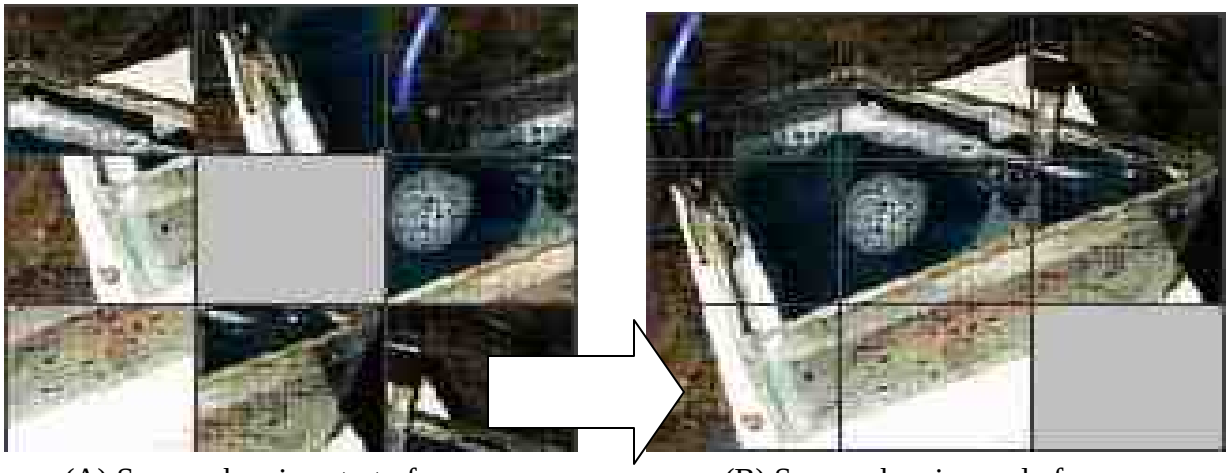
The puzzle game shown in Figure 5 is a Java game to memorize the "Potential - pH diagram" of iron. The colored "Potential - pH diagram" is divided into eight small panels (Figure 5(A)). When these small panels are rearranged, "Potential - pH diagram" of iron is completed (Figure 5(B)). A beginner of metal surface finishing technology can memorize the "Potential - pH chart" of iron by playing this game many times.



(A) Screen showing start of game (B) Screen showing end of game

Fig. 5 Java game to memorize "Potential - pH diagram" of iron

The puzzle game shown in Figure 6 is a Java game to learn "Hull cell". The photograph of the Hull cell is divided into eight small panels (Figure 6(A)). When these small panels arranged at random are rearranged correctly, the "Photograph of the Hull cell" is completed (Figure 6(B)). This game helps beginners of metal surface finishing technology to remember the Hull cell.



(A) Screen showing start of game (B) Screen showing end of game

Fig. 6 Java game to learn the "Hull cell"

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2.2 Modification of “Nervous breakdown” JAVA game

Figure 7 shows a standard Java memory game by a Japanese man. Identical pairs of characters or pictures in the form of panels are arranged at random face down. If the player opens up two identical panels, the panels remain open and the player has won one pair of panels. The game is won when the player turns up all pairs of identical panels.

Fig. 7 Standard “Nervous breakdown” JAVA game

Figure 8 is a memory game in which pairs of identical figures of the "Polarization curve" in the form of panels are to be opened. Six pairs of figures including "Ohm's law", "Polarization curve at decomposition potential", "Anodic polarization curve of stainless steel", "Polarization curve with different limiting current density", "Taffel’s plot", and "Polarization curve with different equilibrium potential" make up the panels. These panels are arranged at random. If two identical panels are turned up, the player wins the two panels. When all identical panels are correctly turned up, the player wins the game.

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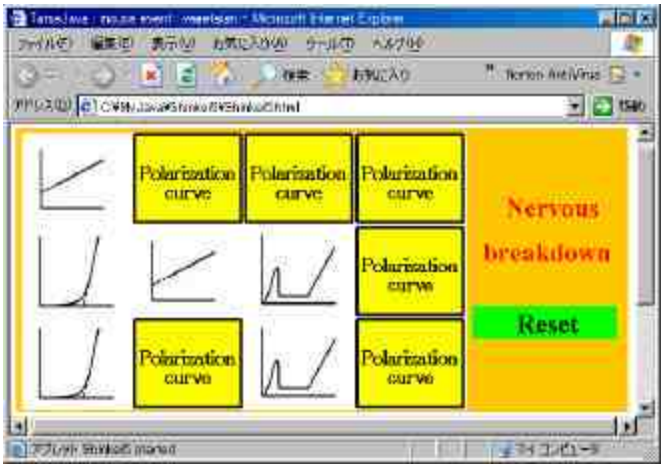

Fig.8 “Nervous breakdown” game of the "Polarization curve"

Figure 9 shows a memory game of electrical symbols. When two identical panels are correctly opened, the player wins the panels. The surface finishing engineer learns electrical symbols by playing this memory game.

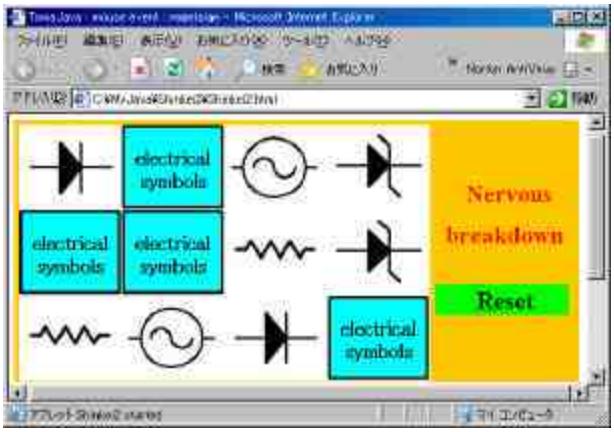

Fig.9 “Nervous breakdown” JAVA game of electrical symbols

Figure 10 is a memory game in which physical quantities are to be matched with their corresponding units. The panels "Voltage and V", "Frequency and Hz", "Length and cm", "Electric current and A", "Area and dm2" or "Current efficiency and %" are to be correctly matched for winning the game. The engineer becomes familiar with physical quantities and their corresponding units by playing this memory game.

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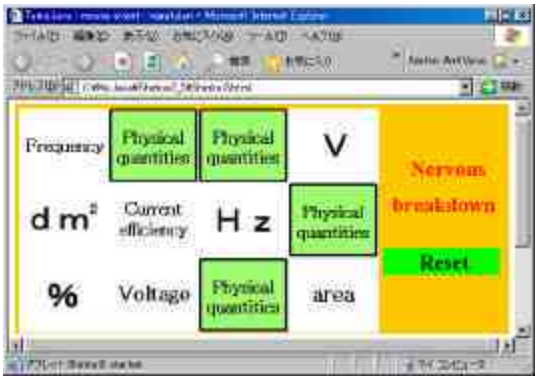

Fig. 10 “Nervous breakdown” game in which physical quantities and their units are matched

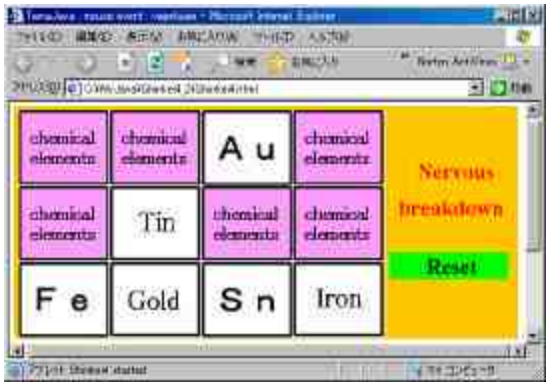

Fig. 11 “Nervous breakdown” game in which chemical elements and their symbols are matched

Figure 11 shows a memory game in which chemical elements and their symbols are to be matched. The panels "Tin and Sn", "Copper and Cu", "Silver and Ag", "Iron and Fe", "Platinum and Pt" or "Gold and Au" are to be correctly matched for winning the game. The engineer becomes familiar with chemical element and their symbols by playing this memory game.

2.3 Modification of JAVA slot game

Figure 12 shows a standard slot game by a Japanese man. Several characters, figures, or pictures are drawn on three rotating drums. If two or three identical characters, figures or pictures appear when the player stops three drums, the player scores points.

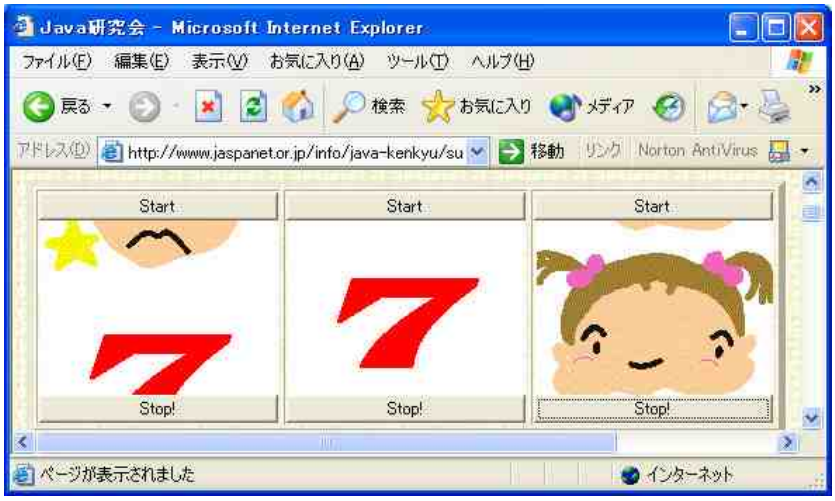

Fig. 12 Standard slot game

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Figure 13 shows a slot game in which photos of scientists rotate. The engineer can remember the names of scientists of electrochemistry by playing this game.

Fig. 13 Slot game in which photos of scientists rotate

Figure 14 is a slot game in which illustrations of chemical apparatus rotate. The engineer can remember "Bunsen burner", "Beaker", "Flask", "Graduated cylinder", "Erlenmeyer flask", "Wide-mouthed bottle", "Desiccator", and "Suction Funnel" by playing this slot game.

Fig. 14 Slot game where illustrations of chemical apparatus rotate

Fig. 15 Slot game where names of electrolysis methods rotate

Figure 15 is a slot game in which the illustrations of the electrolyzing methods rotate. The engineer can learn electrolysis methods such as "Potentiostatic electrolysis", "Step voltage electrolysis", "Constant current electrolysis", "Pulse electrolysis", "Pulse electrolysis of two steps", "Alternating current electrolysis", "AC superimposed on DC electrolysis", and "Periodically reversed electrolysis" by playing this game.

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Figure 16 shows a slot game where keywords related to electrolyte rotate. Engineers can become familiar with terms such as "Anion", "Cation", "Electrolyte", "Solvent", "Complex ion", "Supporting electrolyte", "Ionic strength", and "Separation of ligand" by playing this slot game.

Fig. 16 Slot game where keywords related to electrolyte rotate

Figure 17 is a slot game in which points are scored when two or three inter-related keyword panels appear on the screen as the drums stop. The slot machine game shown in Figure 17 is slightly different from the games shown in Figures 11 to 15 in that two or three panels on the screen should relate to each other if points are to be scored. The combinations of related keywords are eight in number: (1) 2 or 3 nameplates of Helmholtz, Stern and Guy, (2) 2 or 3 nameplates of Taffel, Butler and Volmer, (3) 2 or 3 nameplates of charge transfer control, diffusion control and electrode rate theory, (4) 2 or 3 nameplates of Volta, Faraday, and Galvany, (5) 2 or 3 nameplates of chromium plating, trivalent chromium bath and Sergent bath, (6) 2 or 3 nameplates of nickel, Watts bath and sulfamate bath, (7) 2 or 3 nameplates of copper plating, cyanide bath, and pyrophosphoric salt bath, (8) 2 or 3 nameplates of zinc electroplating, zincate bath and chloride bath.

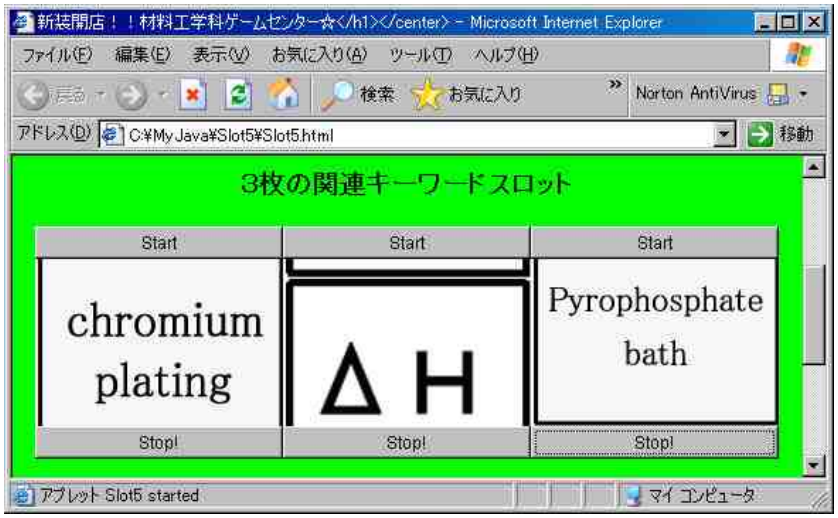

Fig. 17 Slot game in which 2 or 3 inter-related keyword panels are to be matched

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2.4 Modification of other JAVA games

Figure 18 shows a standard mole-striking game by a Japanese man. A player scores by striking a mole as its face protrudes from out of the hole in the ground.

Fig.19 shows the modified mole-striking game. In this game, the “moles” are panels on which names of the aluminum coloring techniques are written. Surface treatment terms such as "Dyeing", "Electrolytic coloring", "Integral coloring", and "Immersion painting" can be remembered by playing this game.

Fig. 18
Standard mole-striking game

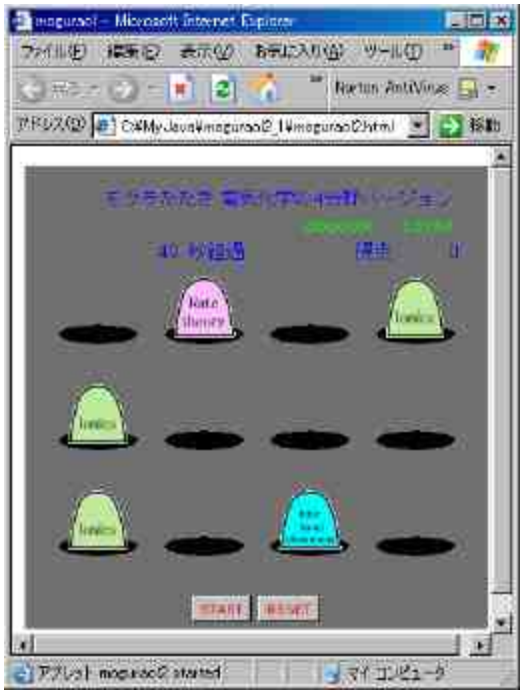

Fig. 19
Game in which panels with names of aluminum coloring techniques (moles) are to be struck

Figure 20 shows a standard block destroying game. The player drives back the ball by the bar drawn on the lower screen and destroys the block.

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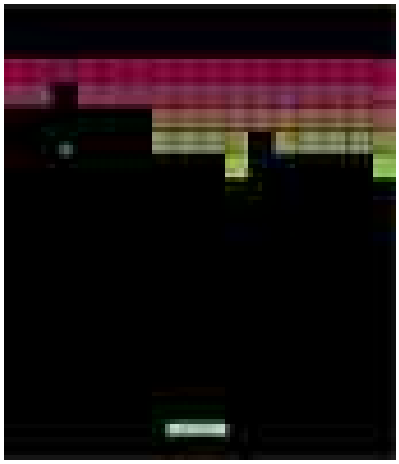

Fig. 20
Standard block-destroying game

Fig. 21
Block-destroying game

The characters “Surface Finishing” appear when all the blocks of the game in Figure 21 are knocked down. Figure 22 shows a standard shooting game by a Japanese man. It is a game in which a picture appears and moves at random. The objective is to shoot down the moving picture.

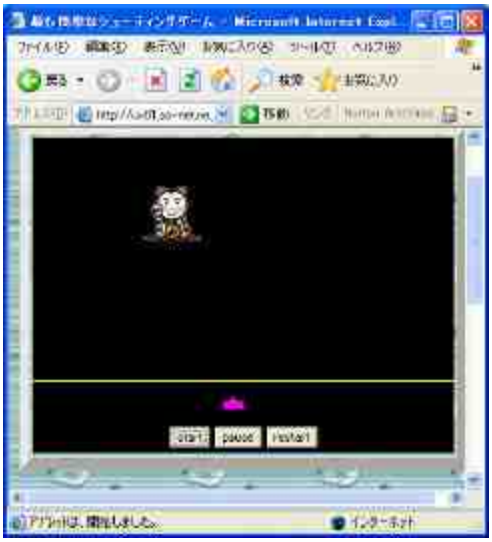

Fig. 22
Standard shooting game

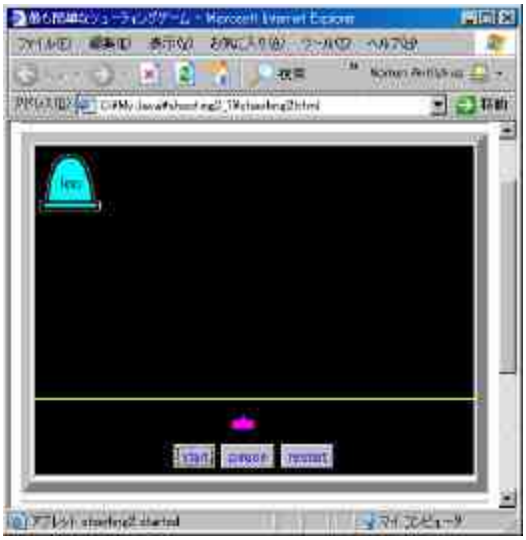

Fig. 23
Game in which alloy names are shot down

Figure 23 is a game in which alloy names such as "Brass", “AZ91D", "304 alloys" and "6063 alloys" are to be shot down. The engineer can master the names of alloys by playing this game.

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3. Educational JAVA animation applets for beginners

Many JAVA animation applets are on the public domain on the Internet. Many Java animations can be found in web sites put up by science teachers in junior high schools and high schools to promote education of science. Such applets related to chemistry are introduced here. Some applets related to electrochemistry created by electroplating companies are available for download from their web sites. Figure 24 is an animation in which dirt on solid surface is removed by a surface active agent. The surface active agent adsorbs on dirt and removes it.

(A) (B) (C) (D)

Fig. 24 Removal of dirt with surface active agent

Figure 25 shows an animation explaining painting by brush to the school child. The surface is prepared first using sandpaper after oil on the substrate is removed with a cloth. The animation also illustrates the procedure for finishing the surface by applying paint many times.

(A) (B) (C) (D)

Fig. 25 Painting with brush

The animation of Figure 26 illustrates electrolysis. A bubble is generated from the anode, and metal plated on the cathode. Figure 27 is an animation illustrating neutralization titration. It is animation in which data such as concentration and volumes of the acid and alkali are to be input, so that the titration curve appears for the input data.

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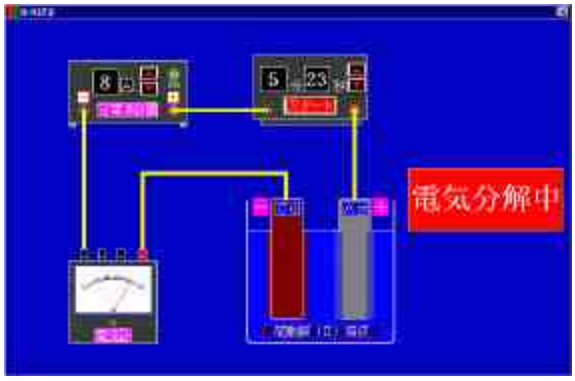

Fig. 26
Animation of electrolysis

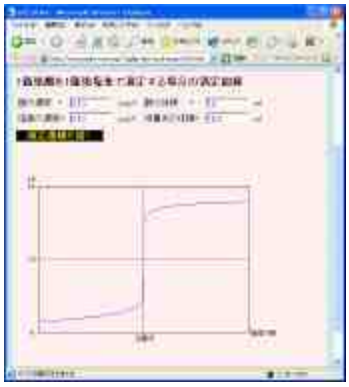

Fig. 27
Animation illustrating neutralization titration

Figure 28 shows a special periodic table of elements. When one of nine buttons shown at the right of this figure is clicked, "Classified display of the metallic element and the nonmetal element" and "Classified display of solid elements, liquid elements, gas elements", etc. are displayed. Figure 28 is a classified color display when the button "Period of Discovery of Element" is clicked. The discovery period is shown as "Ancient times" in red, "Before the 17th century" in orange, "18th Century" in yellow, "19th Century" in green and "20th Century" in blue. The color classifications are made by the Java applet.

Fig. 28 Periodic table of elements classified by condition

Figure 29 is a "Periodic Table Game" which resembles the jigsaw puzzle. Small nameplates of atomic symbols are arranged in the upper part of the screen. The element names are written in a table under this figure. When one small nameplate is dragged to its corresponding element name, the nameplate gets attached to the element name, but does not if the symbol and element name do not match. The game is over when all symbols are attached to their corresponding element names correctly.

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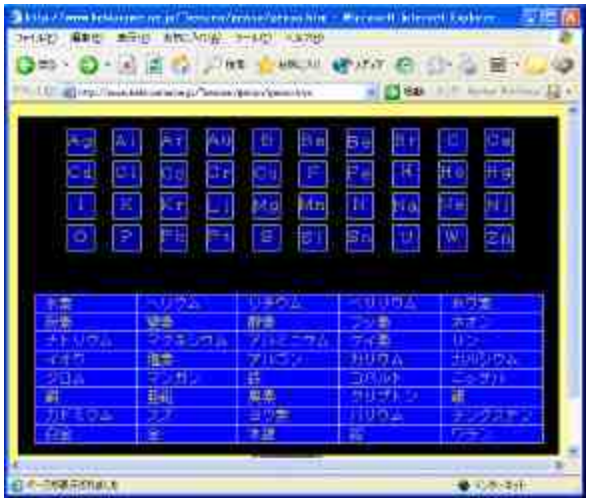

Fig. 29 Game to match element with its symbol

The Japanese Ministry of the Environment recently created "Environmental game" for children and has put up the same at its web site (http://www.env.go.jp /chemi/communication/1-5.html). The game is shown in Fig.30. The website of “Junior ECO Club”(http://www.wnn.or.jp/wnn-jec/english/index_e.html, Fig.31) is linked to the web site of the Japanese Ministry of the Environment.

Fig. 30
"Environmental game" for children

Fig. 31
Top page of "Junior ECO Club”

A group of a young electroplating engineers of Kyoto Electroplaters Association have set up the web site called "Quiz on Electroplating" several years ago, although the programming language used at this site is not Java (Fig.32). The quiz includes 100 questions concerning electroplating to be answered by multiple choices (three). (See Fig. 33).

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Fig.32
Opening screen of "Quiz on Electroplating"

Fig.33
Quiz No.8

These questions are humorous. Figure 33 shows the eighth quiz. The English translation of the eighth quiz is reproduced below.

“What is the law of electrolysis which says "the amount of the material generated at the electrode is proportional at the current and the electrolyzing time?"
1. Faraday's law
2. Friday's law
3. Weekday's law”

A woman's photograph appears if the player of the quiz answers 20 questions correctly. The English translation of the 100th quiz is given below.

"What is the process to make a surface smooth in electroplating called?"
1. Traveling
2. Leveling
3. Bubbling”
Women who successively strip appear one after another when a player answers all 100 quizzes correctly.

4. New idea of “Digital Potential-pH Diagram”

The potential-pH Diagram is important knowledge and tool for the surface treatment engineers and the metallic corrosion engineers (Fig.34). These engineers measure the potential of the metal in solution and the pH of solution. They compare these measurement data to the potential-pH diagram. And, they know the thermodynamics stability of the metal in solution. The method introduced here is the new use of the potential-pH diagram. The stability of the metal is understood without seeing the potential-pH diagram.

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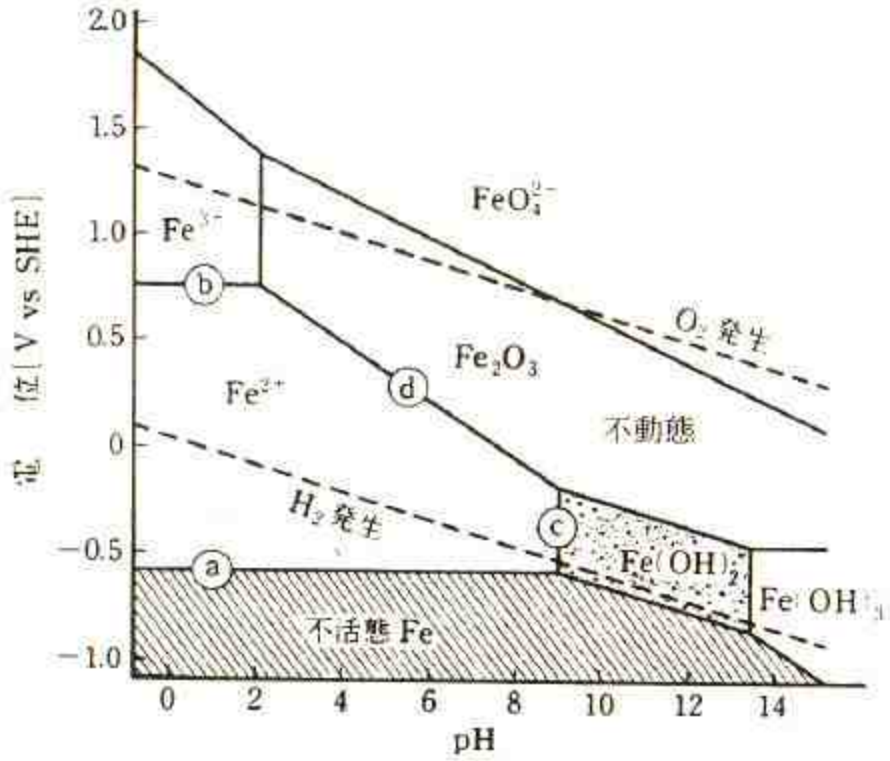

Fig. 34 Potential-pH Diagram of iron

This method is a method of inputting the value of potential and the value of the pH to the personal computer and knowing the stability of the metal (Fig.35).

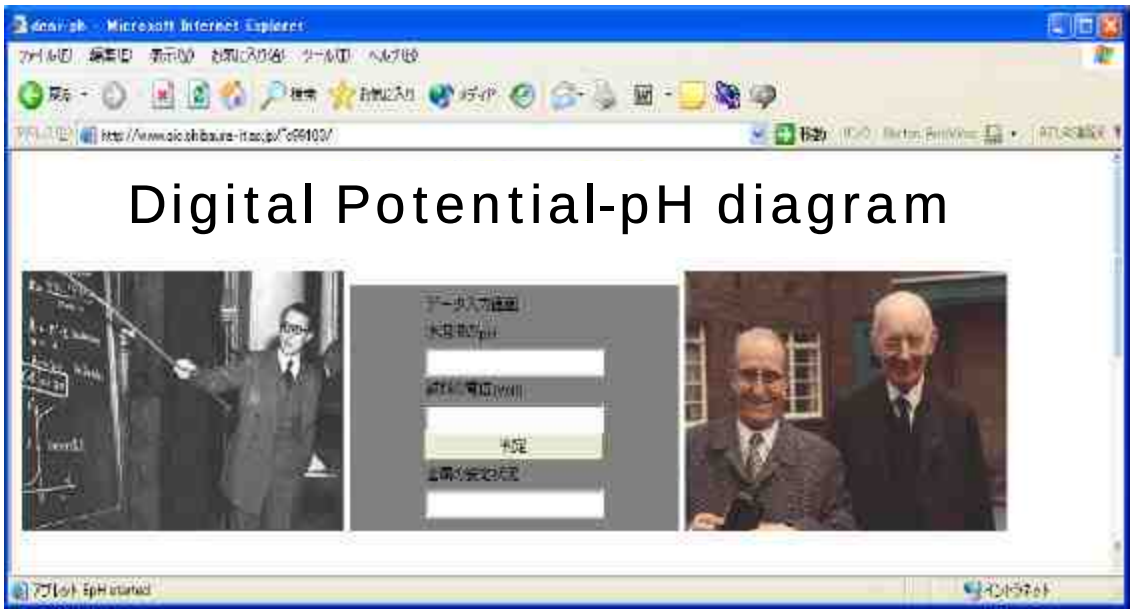

Fig. 35 Digital Potential-pH diagram

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Figure 36 shows the flow chart of the computer programming. Iron corrodes when the answer to the question written in the flow chart is all “YES". Sentences of "Iron is corroded and changed into Fe^{2+} ion" are displayed on the screen of the personal computer. The digital potential-pH diagram can be used even by "Cellular phones which can be connected with the personal computer" and "Cellular phones with built-in Java". The program of the former is written with Perl/CGI. And the program of the latter is written with J2ME.

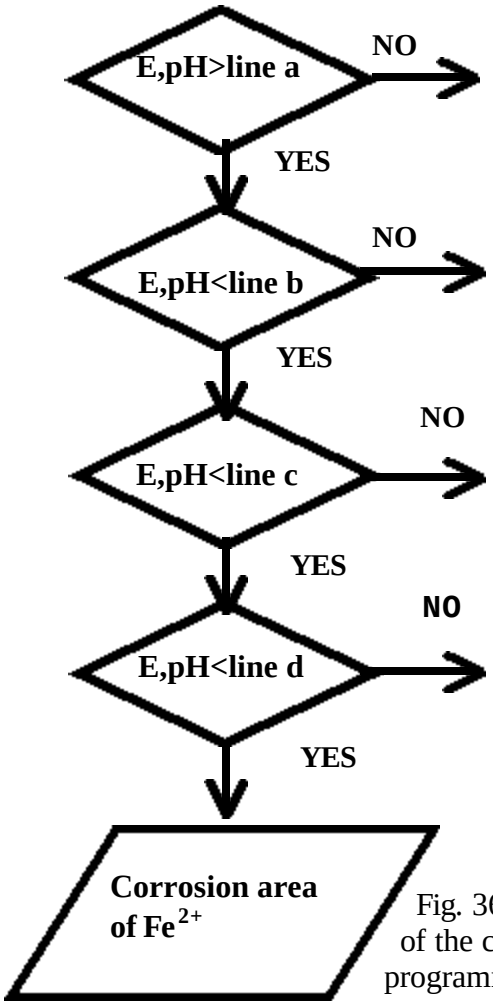

Fig. 36 Flow chart of the computer programming

4. Conclusion

Educational games are much more effective in teaching people a specific subject than other educational methods. Where employee education is to be earnestly implemented, a new game could be created every month, and employees made to compete with each other to attain high scores in the plant. At the end of the month, the winner can be awarded a prize. Such a measure will make education more interesting and motivate the employees to study more.

(A)Screen of data input (B)Top screen (C)Diagram screen

Fig. 37 Potential-pH diagram by mobile telephone with built-in Java

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