Innovation Design of Engineering Experiment Based on Internet

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Abstract. As the progress of innovation design for open experiment in engineering education, it is necessary to investigate the design method based on internet. Through structure analyzing of Browser/Server model, the real time evaluating method in server and system application development are investigated with JavaScript and VBScript as Active Server Page (ASP). As an example of petroleum engineering safety evaluation, MapXtreme resolution and QR code sharing methods for innovation experiment design is discussed. System application and internet sharing of comparison matrix input and experiment evaluation results browse is developed. Finally, the experiment results are analyzed and some advice is proposed.

Introduction

As the progress of web technology, it has been a helpful tool for innovation design of open engineering experiment. Especially, the QR code that is an effective data matrix of two-dimensional code symbol, which was developed by Denso Company, has been made a quickly applied in engineering education based on internet[1,2]. Therefore, services for any users in the world become very convenient through Internet. Meanwhile, web-based services, such as spatial surface analysis, decision making, risk analysis, can be integrated with web. GIS analysis, such as multi criteria evaluation(MCE), can be applied in many fields. The application of integrated information technology has been changed the manner of engineering education, such as open online courses[3-5]. And online remote engineering experiment design will be another technology innovation in engineering education.

As a relatively new method, GIS-based multi criteria evaluation (MCE) has been applied in many field of engineering safety evaluation, such as casing failure analysis in petroleum engineering, land-use suitability evaluation in city planning, risk assessment of disaster[6,7]. There are two types MCE that are including in GIS, Boolean overlay and weighted linear combination(WLC)[8,9]. Because of the needs of many engineering problems for integrated evaluation, this method has broad application prospects[10-12]. Therefore, an innovation experiment design in safety evaluation is discussed in this paper, and this will be a resolution for complicate engineering experiment.

System Structure Design as Basis of Internet

A Browser/Server system structure model is established for engineering experiment, see figure 1.

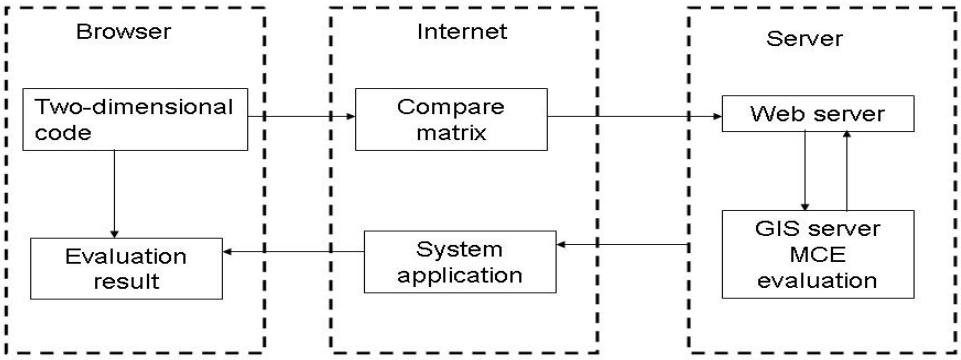

Figure 1. Browser/Server model for Engineering Experiment

It is a three layers model, include browser for users as system application, server layer, and data transition layer. In sever layer, there are GIS server and web server, and many analysis can be achieved in this layer. Customers interact with GIS server through web server, and browse the experiment result through two-dimensional code. Many GIS analysis, such as surface analysis, decision making and safety evaluation, are achieved in the GIS server. ASP is a server side technology to create HTML page for users, and can be dynamic display in customer side. System application program are developed by VBScript and JavaScript language in ASP environment, also, the input parameters table and evaluation results are displayed to customer as asp web page.

Application Example

There are 120 oil wells in the research area, and the data is shown in table 1. In this experiment, we will evaluate the casing failure risk based on 120 oil wells vapor injection data.

Table 1 Well data of vapor injection

No.	Amount of vapour	Injection Number	Injection Pressure	No.	Amount of vapour	Injection Number	Injection Pressure
4-8	14603	6	14.483	18-18	67398	15	12.67333
4-10	5808	3	12.75	18-20	46725	16	12.55625
5-11	31960	12	10.775	18-22	44697	16	11.6062
6-8	9871	4	14.05	18-24	44439	15	12.06
6-10	36989	14	11.9357	18-26	58183	23	12.403
6-12	33810	11	10.87273	18-28	26964	13	12.3153
6-14	40956	13	10.8076	18-30	48521	20	12.91
7-11	21005	8	11.125	19-21	61542	14	17.5142
7-13	32978	12	10.491	19-23	36373	14	10.35
8-10	33495	12	11.55833	19-25	19379	8	11.775
8-14	22888	7	11.8571	19-27	28534	12	10.6083
8-18c	43137	18	12.36111	20-18	32871	11	13.4545
9-11	27736	10	11.24	20-20	57579	19	11.28333
9-13	24082	9	11.07778	20-22	44693	16	12.4375
9-19	18111	7	10.9857	20-24	51608.7	19	12.1
10-8	7262	3	14.3666	20-26	50818	20	11.485
10-10	35955	12	11.305	20-28	14111	9	11.63333
10-14	43996	14	10.6285	20-30	3244	1	11.4
10-18	5464	2	11.25	20-32	5164	2	13.25
10-20	54059	18	12.08889	21-23	48757	19	10.45556
10-g12	5628	3	11.33333	21-25	52788	20	10.018
11-13	22909	8	10.775	21-27	25643	14	10.621
11-15	22185	10	11.13	21-29	11808	5	11.84
11-19	32833	15	10.90667	22-20	66217	24	11.165
11-21	39198	16	17.275	22-22	65106	25	12.496
12-12	7201	3	10.7	22-24	3286	1	15.2
12-14	14842	7	11.3	22-26	52529	22	11.309
12-16	15139	6	12.66667	22-28c	12964	6	10.817

12-18	48157	18	11.4222	22-30	53410	22	13.22
12-20	6941	2	11.25	22-32	8473	4	12.35
12-22	47333	18	12.35	22-G24	49429	18	10.947
13-13	16139	8	11.7	23-25	29132	12	11
13-15	14150	6	12.06667	23-27	18304	11	11.236
13-19	38296	15	11.38667	24-24	67009	29	12.025
13-21	36793	17	11.49333	24-26	27695	13	11.675
13-23	47142	18	10.71667	24-28	19661	7	11.5
14-12	20009	7	13.3	24-30	4503	2	14.15
14-14	26886	10	12.87	24-32	39844	17	14.859
14-16	9499	5	12.76	24-34	5061	2	12.5
14-18	60406	20	12.02	24-36	23540	10	12.39
14-20	39853	14	11.7857	25-27	24239	11	13.409
14-22	45661	16	12.4812	26-24	19634	9	11.9
14-24	18448	10	12.37	26-26	57441	20	12.742
15-19	43295	16	11.12667	26-28	40731	15	13.527
15-21	43681	17	10.6	26-30	33617	14	15.35
15-23	42702	17	12.0705	26-32	3553	2	14.9
15-25	37020	15	11.55333	26-34	36457.9	15	13.91333
15-27	10100	5	13.12	26-36	5857	2	14.75
16-16	18301	7	11.9428	28-28	53888	20	13.4
16-18	30489	10	11.12	28-30	19763	10	16
16-20	23346	10	10.91	28-32	55383	25	14.528
16-22	21915	8	11.575	28-34	21033	11	14.72
16-24	22070	8	11.7571	28-36	43429	18	14.43
16-26	13457	7	12.2571	28-38	11471	5	15.733
16-28	34017	11	12	30-28	20126	9	15.644
17-21	41297	15	10.49333	30-30	44696	18	14.7625
17-23	34794	15	11.1571	30-32	29496	18	14.494
17-25	14418	5	10.66	30-34	48001	16	15.12
17-27	22961	9	11.7111	32-26	9598	9	17.525
18-16	26388	8	12.975	32-32	19037	9	14.625

The results of weights are 0.11, 0.31, 0.58, and index of consistency is 0. The evaluation result of this experiment is shown as figure 2. The two-dimensional codes are shown as figure3.

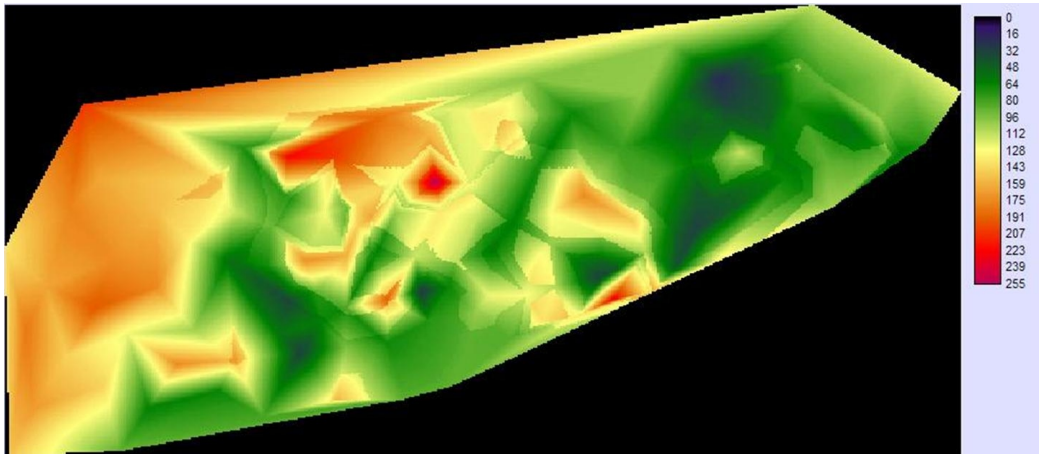

Figure 2. Experiment calculating result

(a) Input data (b) Result access

Figure 3. Two-dimensional code

The two-dimensional codes is for data input and result browsing. Therefore, this engineering experiment can be fulfilled though mobile with two-dimensional code as basis of internet. Therefore, students can do the experiment through internet conveniently.

Conclusions

Through system structure design, an open experiment was developed for distance education, and students can fulfill engineering experiment with mobile with internet. MCE method is applied to evaluate the risk of casing failure as basis of 120 oil wells' data. In AHP method, the lack of consensus comes from the inconformity of comparison matrix. Therefore, to keep the conformity among factors in comparison matrix is the way to avoid error. The degree of consistency changes with the conformity among factors.

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