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WEB LEARNING OF HYDRAULICS

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Abstract: *Web learning of hydraulics is an application whose main goal is distributing knowledge and giving examples to students during studying hydraulic systems through an array of on-line interactive examples. A number of examples is suited for classes Hydraulics and pneumatics and covers basic hydraulic systems and hydraulic functional schemes, while other examples cover more complex systems and schemes.A student, user, is given an opportunity to change position of, for example, distributors, pressure in safety valve, pump power, etc. and at the same time, ability to see the changes on the screen and get the full calculation of a hydraulic system. Web hydraulics is written in JavaScript and MathML script language, which has enabled displaying of calculation of the system with necessary mathematical symbols in an HTML document. To use this application, users should have an Internet browser, free MathPlayer plug-in and Internet connection.*

Key words*: web learning, hydraulic systems, Internet programming, mathematics on web.*

1. INTRODUCTION

Today, automatization is present almost everywhere and its usage is common in daily activities. It is one of the more important fragments, which form today's society's developments, and many would say that it is a progress generator of today's society.

Hydraulics and pneumatics are two cornerstones of automatization itself. More complex systems of management, regulation and process control are based on them. Giving that, hydraulic and pneumatic systems are included in automatization. Research has shown that production growth is based on systems that use automatization based on those two elements. Other complex systems, which use elements of sensorics, regulation and control, are using the two as foundation.

Control schemes show assembly solutions, which use laws of fluid mechanics to achieve power transfer, regulation of velocity and pressure, synchronization of multiple cylinders etc. Hydraulic system has three main subsystems: hydro pump, control unit and electrical engine.

At the entry point of the system, mechanical energy is converted into hydraulic energy through electrical, petrol or diesel engine and is converted back into mechanical energy at the exit point.

Task of the hydraulic system is changing the parameters of the particular components, which interact among themselves: force, velocity and movement. This gives ability for certain parameters to change their nature, for example, force can be linear or momentum, velocity can be linear, rotational, angular, oscillating…, movements can be linear or angular, etc.

Hydraulic system is described with symbols representing hydraulic elements connected through pipes: pumps, batteries, cylinders, actuators, various valves for flow management (distributors, check, silencing, regulators) and pressure management (pressure regulator) and others like pipelines, filters, different hydraulic components…

In practice, hydraulic systems consist of various subsystems such as power transfer assemblies, velocity regulation…

These systems are being lectured in collegium Hydraulics and pneumatics at FSB. The goal of this project is to enable smooth adopting of this knowledge through the web, so that the students could solve homework of the hydraulic schemes of the current day at home in the most desirable way, visually. Web H application allows them to study the scheme and enter desirable values of, for example, exit force from the hydro cylinder and its dimensions, to set the current or the power of the hydraulic pump and enter a value for the margin pressure value for the pressure valve. Then, by changing a position of the distributor they can get a current view of the scheme with the given pressure values, currents and other important parameters in the system and also a clear view of the calculation itself, which represents solved homework.

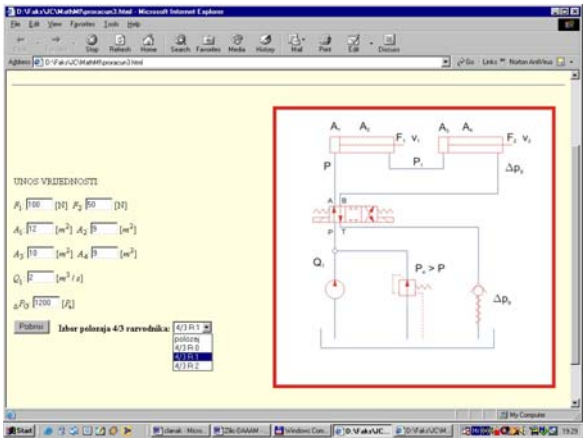

Fig. 1. working screen of Web learning of hydraulic

Later position adjustment of the distributor or margin pressure value gives the ability to track the system changes. This is just an example, allowing implementing of hydraulic motors instead of cylinders and also a throttle or closing valve can be positioned.

2. MATHEMATICAL SYMBOLS ON THE WEB

One of the disadvantages of the HTML is lack of display of mathematical symbols, such as exponents, integrals, fractions etc. As the ability to display mathematical symbols is important for the engineering tasks, the browsers such as Amaya (which supports the display of the MathM1) were developed. With the addition of the plug-ins other browsers can display XML tags and MathM1.

```
<m:math>
        <m:msup>
        <m:mi>m</m:mi> <m:mn>2</m:mn>
        </m:msup>
</m:math>
```

Fig. 2. MathMl code note for x^2

MathML is a low-level specification for describing mathematics as a basis for machine-to-machine communication. It provides a much-needed foundation for inclusion of mathematical expressions in Web pages. MathML is cast as an application of XML. As such, with adequate style sheet support, it will ultimately be possible for browsers to natively render mathematical expressions. Many implementations of MathML are available (browsers and authoring tools), many of which are open source software. We have been using a free plug-in in MathPlayer (http://www.dessci.com/) which is easy to install and is called from within HTML code.

```
<OBJECT
    ID=MathPlayer
    CLASSID="clsid:32F66A20-7614-11D4-BD11-
00104BD3F987"
  >
  </OBJECT>
  <?IMPORT NAMESPACE="m"
IMPLEMENTATION="#MathPlayer" ?>
```

Fig. 3. Calling MathPlayer from our HTML Page

Similar to web page in HTML, mathematics with appropriate symbols is written in MathM1 mark-up language. When a web page written in MathML language is loaded into a web browser, it is translated through a MathPlayer into a readable document with mathematical symbols.

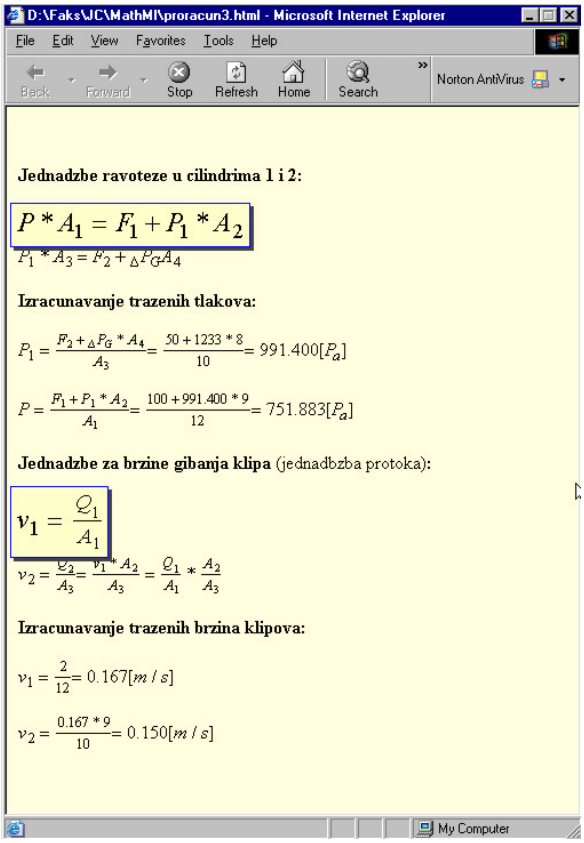

Fig. 4. Mathematics simbols on web displayed by MathPlayer

```
s9="<m:math><m:msub><m:mi>v</m:mi><m:mn>1</m:mn>
</m:msub><m:mo>=</m:mo><m:mfrac><m:msub><m:mi>Q
</m:mi><m:mn>1</m:mn></m:msub><m:msub><m:mi>A</
m:mi><m:mn>1</m:mn></m:msub></m:mfrac></m:math>"
novipr.document.write(s9);
```

Fig. 5. MathML code for the variable v1

3. USING OF LAYERS

For display of the hydraulic schemes, layers have been used. For example, the scheme from fig. 1 has been divided into three pictures, each of which is on one layer. The distributor is on one layer, while the hydraulic elements are on other layers. It was important not to waste time with page refreshing, so we have three layers with three different positions of the distributor. Through JavaScript we simply change attribute of the particular layer from visible to hidden and vice-versa and an effect of immediate change of position of the distributor is achieved, without refreshing the page content.

```
<div id="Layer2" style="position:absolute; width:500px;
height:500px; z-index:2; left: 468px; top: 242px">
      <div align="left"><img src="razvodnik1.jpg"
width="143" height="30" vspace="176" hspace="45"></div>
      </div>
```

Fig. 6. Layer tag with style and attributs

Function *change(i),* written in JavaScript, based on the value *i* which carries data about newest position of the distributor, changes attributes in layers styles and calls function, for example, *solve(),* which based on the same value and entered values gives the result in MathM1 record which is displayed through HTML as shown in Fig. 4.

```
if (i==0) {
        if (document.layers)
          document.layers["Layer2"].visibility='show';
        else
          document.all["Layer2"].style.visibility='visible';
        if (document.layers)
          document.layers["Layer3"].visibility='hide';
         else
          document.all["Layer3"].style.visibility='hidden';
          }
```

Fig. 7 Changing layer attribute with JavaScript function

4. CONCLUSION

Web hydraulic learning is an application which would be of great benefit to the students of the automatization, robotics, also it will encourage authors in further development of the application in simulating particular hydraulic systems in a way that each hydraulic element would be assigned particular mathematical function thus establishing interaction between elements. This application would offer much more options and an ability of database in which functions could be entered describing particular elements. Also, the application could cover onto field of electrotechnics, electronics, automatic regulation and much more.

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