

Virtual 3D reconstruction of historical vehicles: Columbia electric car and Kulibin's pedal carriage

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Historical vehicles - a part of technical heritage

- 1901 Columbia electric car – an exhibit of the Moscow Polytechnic Museum.
- Kulibin's pedal carriage of the late 18th century - only drawings survived.



Reconstruction by A. S. Isayev (1955), replica 1:5

Advantages of virtual reconstruction vs physical prototyping

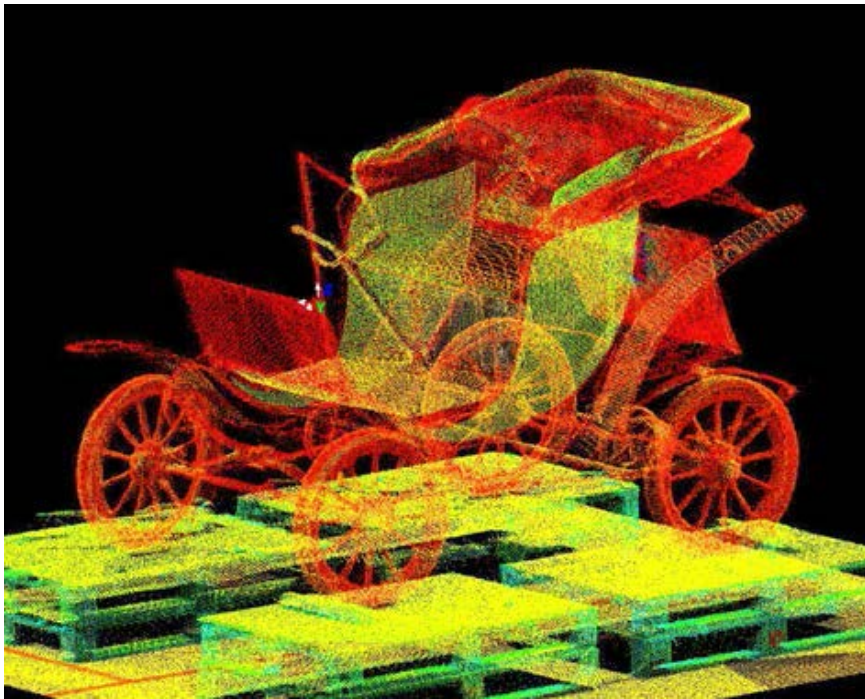
Virtual reconstruction overcomes the limitations of physical prototyping, and allows you:

- To present several versions of the object design.
- To demonstrate the internal structure of the object.
- To animate an object and interactively demonstrate its action.

Additional benefits of virtual reconstruction

- Saving information about the existing state of the exhibit (geometry, structure, color and texture of surfaces) in the format of a 3D document
- A detailed historical and technical study of the structure of the exhibit, including its individual subsystems
- Restoration of the lost structural elements in a virtual form, testing hypotheses about their spatial location and structure.
- Preparation for the physical restoration of the exhibit.
- After the physical restoration of the exhibit, its virtual model can be used to control the quality of the restoration.
- The created 3D model can be used as a virtual exhibit for demonstration to the public.

Columbia electric car: laser scanning and 3D modeling

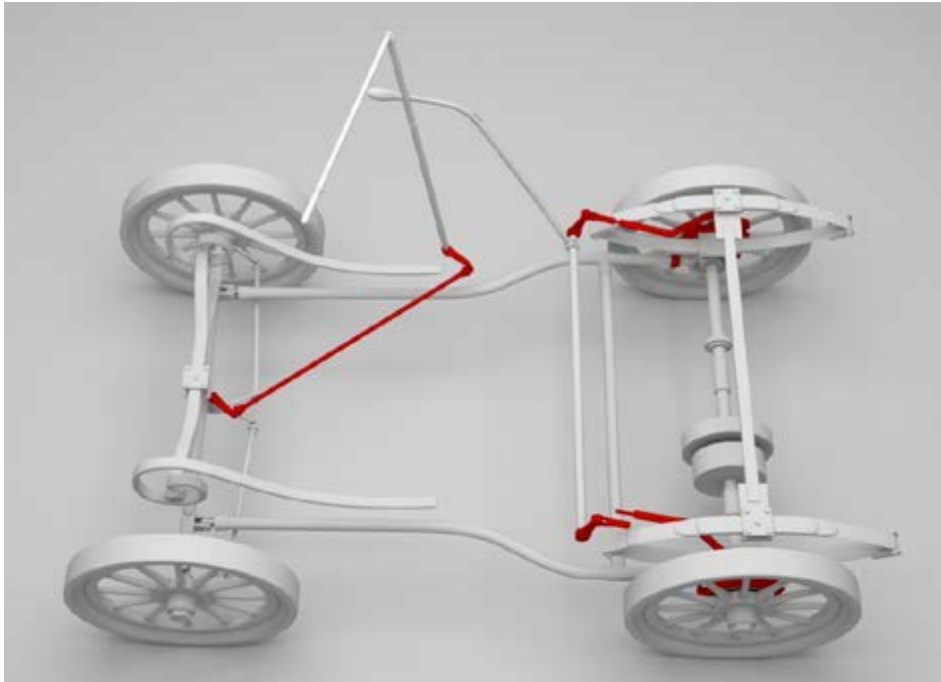


Laser scan result: 3D point model of an electric car (point cloud).

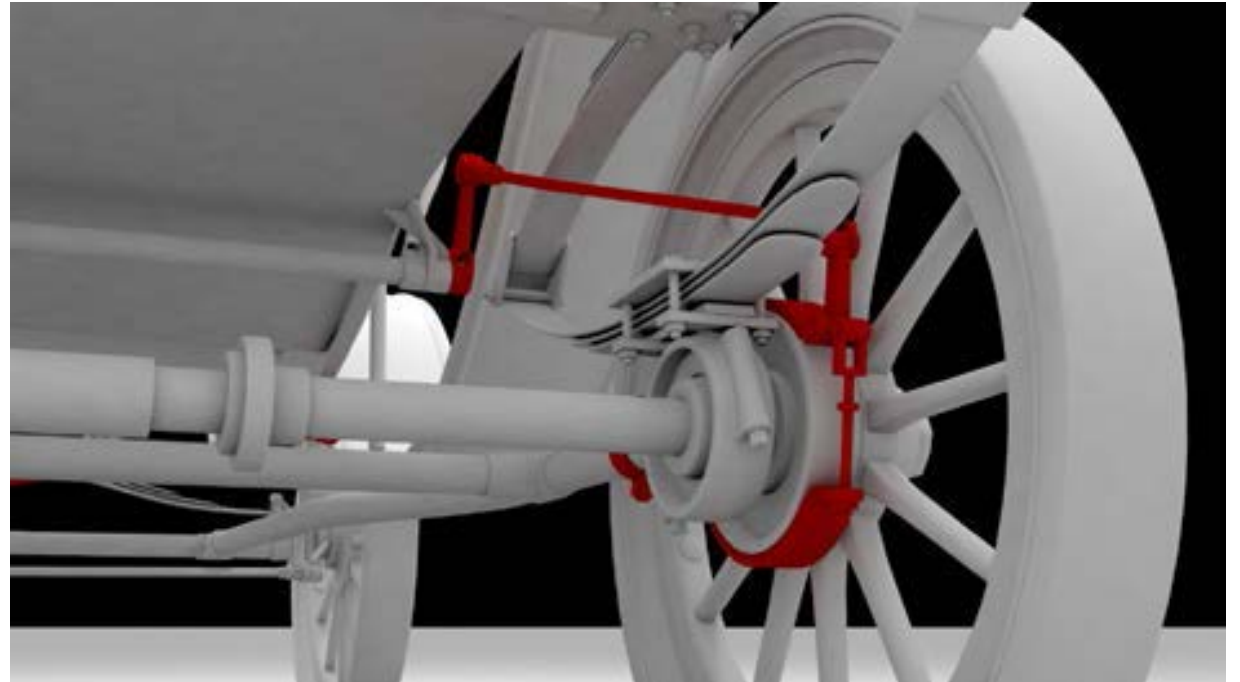


Textured 3D model of the Columbia electric car.

Columbia electric car: virtual reconstruction of the lost elements

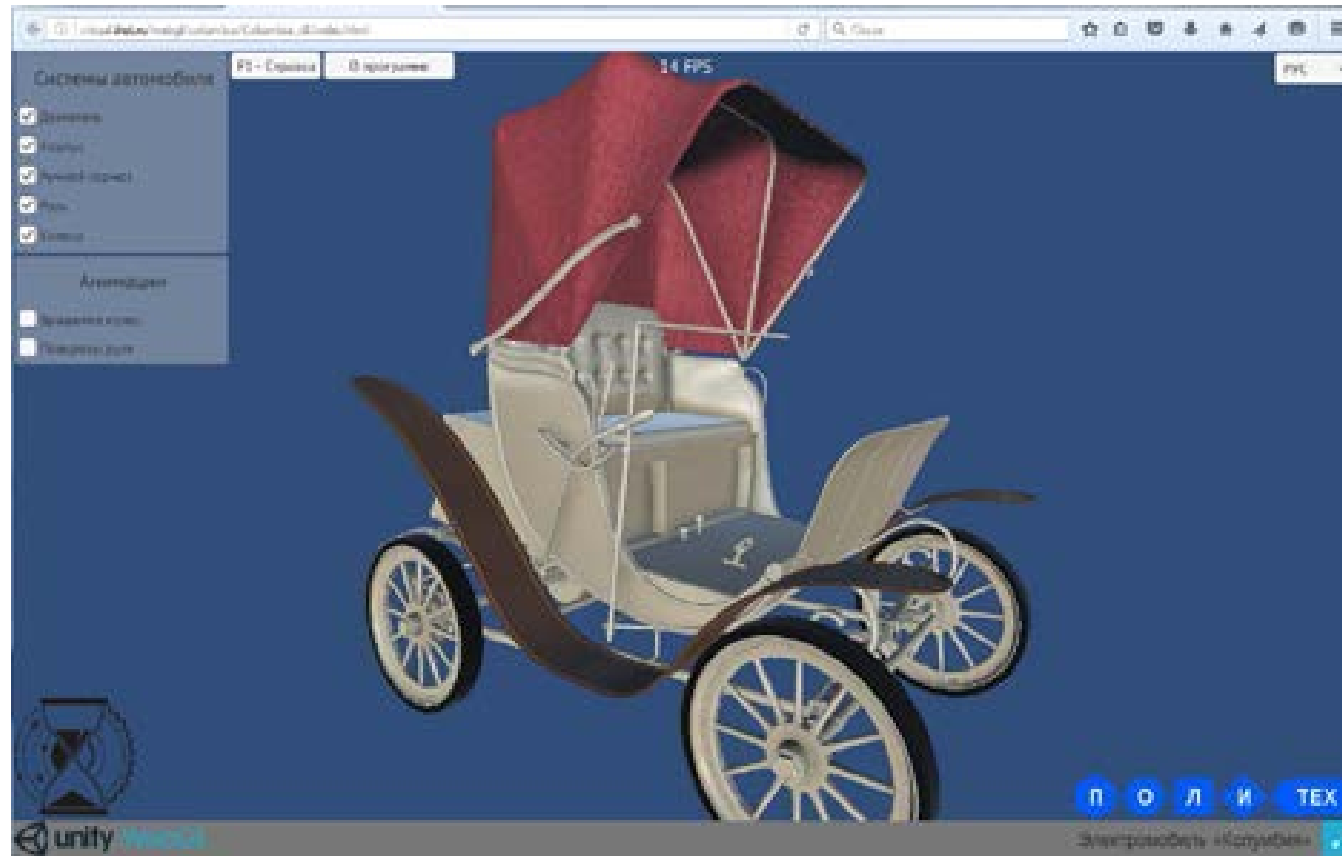


Missing elements recreated virtually in 3D model: main steering rod and rear wheel brakes



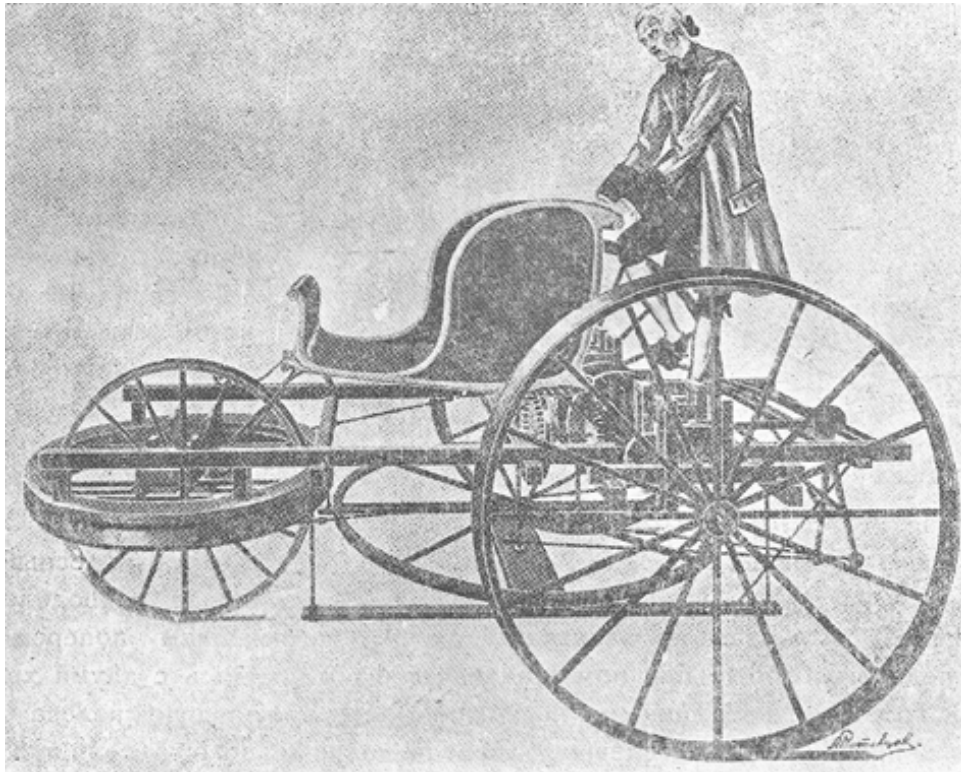
Brake mechanism rebuilt using 3D modeling of existing dismantled parts and photos of a similar car from the Bewley Museum

Columbia electric car: interactive web application



The application is available at the link:
<http://virtual.ihst.ru/columbia.html>.

Kulibin's pedal carriage: historical reconstructions

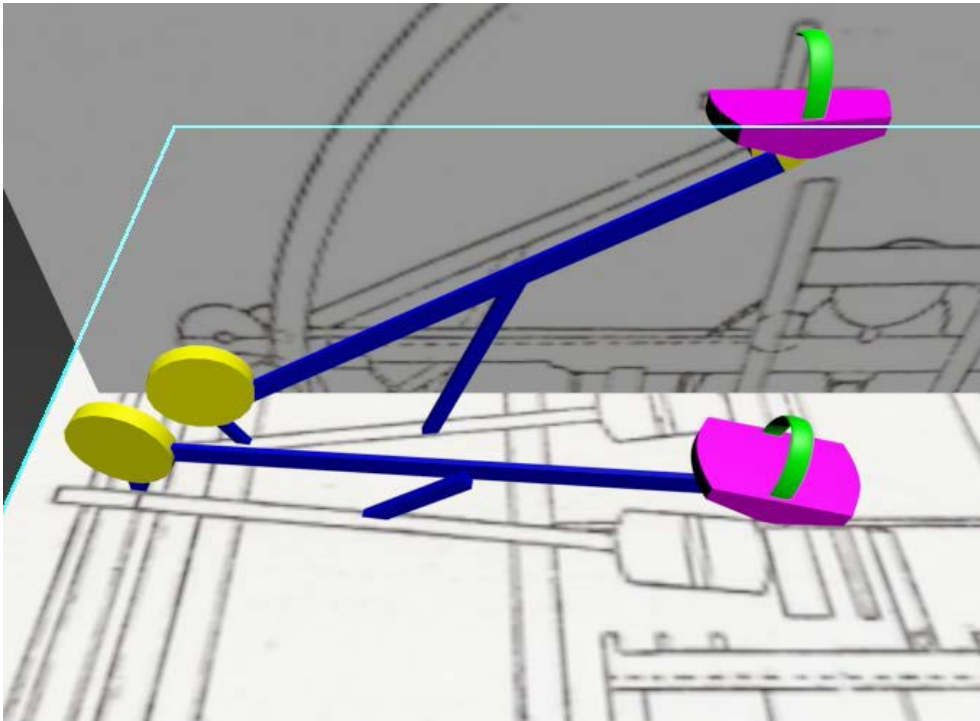


Reconstruction by I. A. and A. A. Rostovtsev (1935), drawing

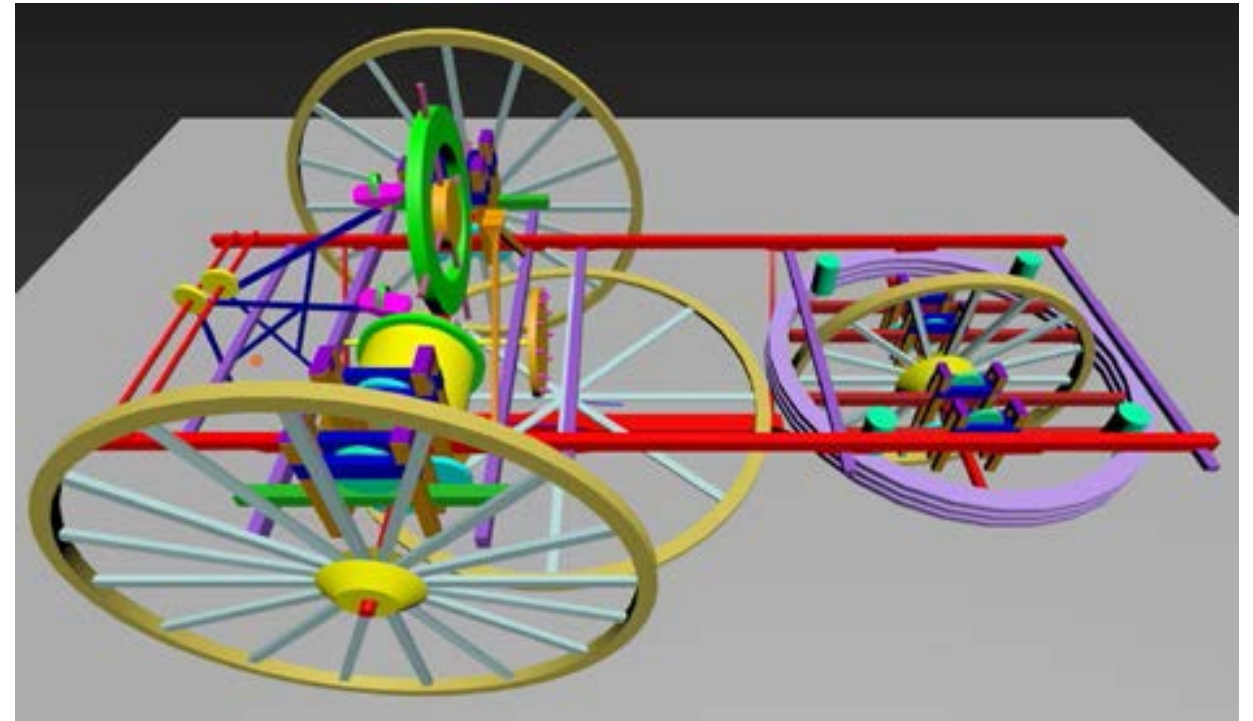


Reconstruction by A. S. Isayev (1955), replica 1:5

Kulibin's pedal carriage: virtual 3D-modeling



Pedals 3D model attached to two drawings.



3D reconstruction of a three-wheeled pedal carriage.

Conclusions

- In the case of the Columbia electric car, we created a visually and historically realistic 3D model of the electric car, including a virtual reconstruction of the lost mechanical elements. We virtually animated the action of the mechanical components of the car and demonstrated the operation of the steering system. The created model reproduces the visually accurate historical appearance of the car, and allows you to demonstrate its structure and principle of operation. This model can be used to plan the subsequent physical restoration of the vehicle, as well as to display this artifact of technology to the public.
- In the case of Kulibin's pedal carriage, we have shown that with the help of simple techniques and modeling tools it is possible to "revive" inventions of the past, to visualize drawings in the form of interactive computer 3D models. The toolkit necessary for this is very simple and accessible even to a schoolchild.

Acknowledgment

The author is grateful to his colleagues from the IHST RAS Ivan Rys', Alexander Bobkov and Nikolay Ulyanov for collaborative work on 3D modeling historical vehicles and developing an interactive application, as well as to employee of the Polytechnic Museum Maxim Kartashev for invaluable assistance in obtaining and analyzing historical documentation for the Columbia electric vehicles. The author also thanks the Navgeokom company and personally Sergey Kotelnikov and Dmitry Kovalev for performing laser scanning of the Columbia electric car and primary processing of its results.