OcuPhysics: Modeling Electricity in Virtual Reality

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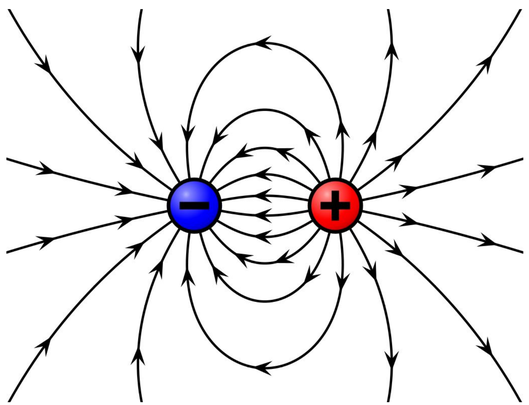
Kevin Chaplin, Sherry Wang, Bernice Wu

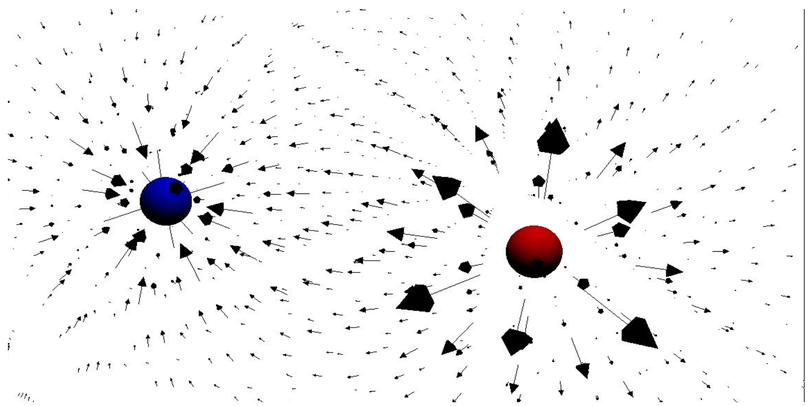
Background

Point charges generate electric fields. An isolated positive charge generates a field pointing radially outwards while an isolated negative charge generates a field pointing radially inwards. The magnitude of the electric field can be described by Coulomb's Law:

$$\vec{E} = \frac{kQ}{r^2}\hat{r}$$

where E denotes the electric field at a point, Q is the charge, k is Coulomb's constant, r is the distance from the charge to the point, and r̂ is the unit vector pointing from the charge to the point in space.





Two opposite point charges with resulting electric field.
Left: typical 2D diagram. Right: 3D simulation.

Technologies Used

Three.js | Node.js & NW.js

Oculus Rift

Leap Motion

Development

I. Simulation

Using Coulomb's Law, we generate the electric field direction and magnitude at regular points in space, then display a vector accordingly.

II. Interaction

When the user changes the positions of the point charges, the electric field changes accordingly. The user can also pan, zoom, and rotate.

III. Oculus Rift

The Oculus Rift displays the electric field such that it fills the user's entire field of view for an immersive experience.

IV. Leap Motion Controller

We used the Leap Motion sensor to detect hand gestures as input. For example, pointing with the right hand enables the movement of point charges.