In this thesis we consider the action of the exceptional simple Lie group F_4 on the so called (real) Moufang plane $\mathbb{OP}^2_{\mathbb{R}}$. The goal of this thesis is to present a proof of the transitivity of this action, which is as complete as possible. We first define related concepts such as Clifford algebras, the groups $\mathrm{Pin}(r,s)$ and $\mathrm{Spin}(r,s)$ and the algebra of octonions $\mathbb{O}$, and we prove their basic properties. The group F_4 is defined as the automorphism group of the algebra $\mathcal{J}_3(\mathbb{O})$ of hermitian octonionic matrices of order three. The Moufang plane is defined as a suitable subset of $\mathcal{J}_3(\mathbb{O})$. In the group F_4 we find isomorphic copies of the groups $\mathrm{Spin}(0,8)$ and $\mathrm{Spin}(0,9)$. By applying certain auxilliary results from the previous chapters we obtain the desired proof of the transitivity of the action of F_4 on $\mathbb{OP}^2_{\mathbb{R}}$.