A three-dimensional imaging apparatus for imaging a three-dimensional object may include a microlens array, a sensor device, and a telecentric relay system positioned between the microlens array and the sensor device. A telecentric relay system may include a field lens and a macro objective that may include a macro lens and an aperture stop. A method of imaging a three-dimensional object may include providing a three-dimensional imaging apparatus including a microlens array, a sensor device, and a telecentric relay system positioned between the microlens array and the sensor device; and generating a plurality of elemental images on the sensor device, wherein each of the plurality of elemental images has a different perspective of the three-dimensional object.