With rising labor costs and high consumer demand, economic conditions are becoming increasingly favorable for mechanization in the strawberry industry. However, virtually all strawberry crops are still picked by hand because the harvesting process is very challenging to automate, and strawberries are susceptible to bruising. For these reasons, the development of a harvester which can avoid damaging the fruit is of interest. Conventional designs for robotic grippers are less than ideal, as precise positioning or force feedback capabilities are required to reduce the risk of bruising. As an alternative, a novel "camera-in-hand" gripper design is presented which effectively avoids bruising by containing the fruit in a spherical shell before pulling away from the plant. Additionally, a corresponding visual servo control system is also presented for positioning the gripper with an XYZ table. Camera feedback paired with a color-based filtering method identifies and locates strawberries of sufficient size and ripeness. If a strawberry is found, alignment errors between the gripper and the target fruit are updated through a discrete Kalman filter for noise reduction. Validation of the autonomous harvester consisting of the gripper, XYZ table, and associated visual servoing software is conducted via field tests on the Florida radiance cultivar grown in plasticulture.