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A low cost 3D-printed robot joint torque sensor

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Recent technology advancements enable researchers and engineers to develop a sophisticated robot arm. A robot arm is usually constructed with modular joints wherein every joint is equipped with position, velocity and torque sensor and can be controlled by its position, velocity and torque command. Therefore, a robot arm controller can be designed in such way that the robot arm can move along the desired trajectories and act upon external influences in this last case, the torque sensor plays an important rule. The following robot applications require feedback signals acquired from torque sensors embedded in each robot joint hand-guided robot motion, robot imitation learning and safe human-robot interaction. Regardless the built quality, the sensitivity and the accuracy of the commercially available torque sensors, they usually are high cost. In this work, an inexpensive robot joint torque sensor is presented. Most of the joint torque sensor parts are built with 3D-printed materials. Other components of this sensor are widely available and can be purchased with relatively low price, for instance, bolts, screws, roller, flexible coupler and springs. The main objectives of developing this sensor are to specifically prototype a robot arm for education and research purposes. The basic idea of the sensor mechanism is to transform the torque into the force absorbed by the springs. The roller moves the spring footing plate up or down following the V shape floor, depending on the direction and the magnitude of the input torque. Then, the quadrature optical encoder senses the direction and the magnitude of the input torque. This robot joint torque sensor can be easily assembled and disassembled. Thus, the accuracy and the torque specification can be redesigned to meet a specific application's requirement by substituting the encoder and the spring, respectively. The mechanical's construction of this sensor is designed in such way that the attachment of the robot joint actuator and link can be easily established. The duration of the 3D-printing process of the sensor parts was seven hours. The 3D-printer like PRUSA i3 was used. The printer was fed using PLA filament.

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