INTRODUCTION
The objective of this design project is to design a device that reduces the effect of mild arthritis and aids in leg injury rehabilitation. The device has two main features. Firstly, the device will act as a knee brace to support the joints. It takes the excessive pressure off the knee which would otherwise be experiencing the effects of vertical forces. It will result in less wearing of the cartilage in the knee, and the user will not feel as much pain. The second feature is the resistance mechanism which will add resistance against the motion of the knee joint to help strengthen the muscles and ligaments surrounding the knee. The resistance can be adjusted, depending on the effort needed for effective use.

SUMMARY OF IMPACT
People who suffer from knee arthritis experience discomfort as a result of excessive vertical forces on the knee. In most knee arthritis cases the muscles and ligaments of the leg are too weak to support the knee. This can cause knee joint to wear and a considerable amount of pain. By acting as a knee brace, the device provides support to the muscles and ligaments surrounding the knee. On the other hand, used as a resistance training device, it builds muscle and ligament strength. By increasing the strength of muscles and ligaments in the leg, the knee will be better supported.

TECHNICAL DESCRIPTION
A resistance mechanism is attached to a knee brace in place of a standard hinge. The user can select the appropriate force range by turning a handle and then locking the
mechanism with a thumbscrew. Thus, as the user walks, he will feel a resistance to the motion of the knee.

The key component to the resistance mechanism is a spiral torsion spring that has its center fixed to a hexagonal shaft. The outer edge of the spring is constrained to the lower leg, attached to the user’s upper calf. As the knee is flexed, the end of the spring undergoes deflection and the resulting force acts in the opposite direction to the movement of the calf.

In order to control the preload on the spring, a ratchet mechanism is used. It consists of a ratchet wheel, two pawls and a cam. The two pawls constrain the ratchet wheel from spinning in a certain direction. The cam engages with the pawls at four specific rotary positions, moving them in and out of contact with the ratchet wheel. Rotating a thumbscrew connected to the cam allows the user to choose between increasing the preload, locking the mechanism, decreasing the preload, and a zero resistive force mode. All of these components were made of 303-Stainless Steel.

The outer casing contains the spring as well as the ratchet components, and is made of 6061-Aluminum. It is attached to the two hinge plates via a press fit bushing. These hinge plates fit into sleeves on the side of the knee brace. The compact design allows it to fit on the knee brace in place of the preexisting hinge.

The cost of the parts and supplies for this project was $235.

Figure 19. Design of Resistance Mechanism