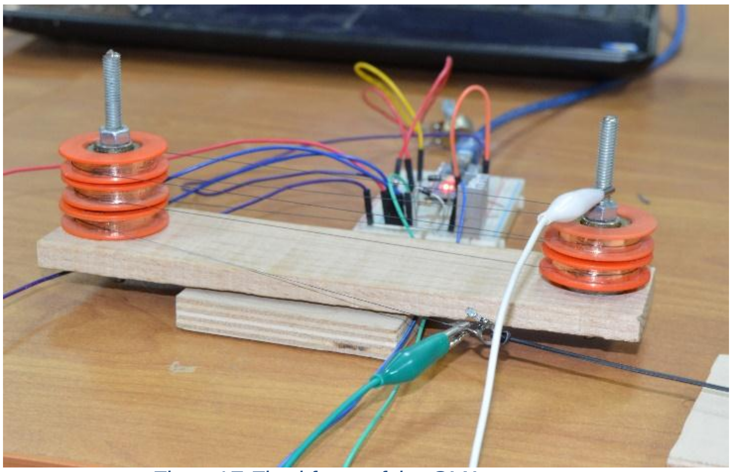

Fig. 17 Final form of the SMA actuator.

6. CONCLUSIONS

Actuation of the specified robotic joints proved to be successful by replacing the already existing DC motor with a SMA actuator. The actuator provided less power consumption when compared to the DC motor by 79%. Also with the absence of power transmission technique represented by the toothed belts and gears, power loss due to friction factor has no noticeable effect besides that of the small value due to the presence of pulleys. Although reducing the size of the original prototype by 57% still did not provide a competitive size compared to compactness of the DC motor, it provided a lighter actuator. Additionally, the SMA actuator can be further reduced to be without a wooden base and be placed inside robot's members as pulleys and rods to be mounted inside the arm, taking quite a small space and gaining the advantage over the DC motor. The SMA provided no audial noise during contraction or elongation. The bandwidth of the actuator is considered to be reasonable with a contraction occurring in less than a second and an elongation taking less than 3 seconds; a value achieved by applying forced air cooling. The main challenging aspect about SMA actuators is providing a method of control due to their non-linearity and hysteresis during the contraction and elongation. A model was successfully created to capture the behaviour of the hysteresis of the SMA, this was done through Hammerstein-Weiner model with a curve fit of 99%. Thus, SMAs are considered extremely beneficial materials when it comes to actuation applications of robotic joints. Their distinctive properties place them a head competitor with conventional actuators. Of the various types of SMAs for robotic joint actuators, NiTi proved to be the best alloy.

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