Mechatronics and Making
Mid Project Report
Exoskeleton Robotic Hand With Wolf Claw Mechanism

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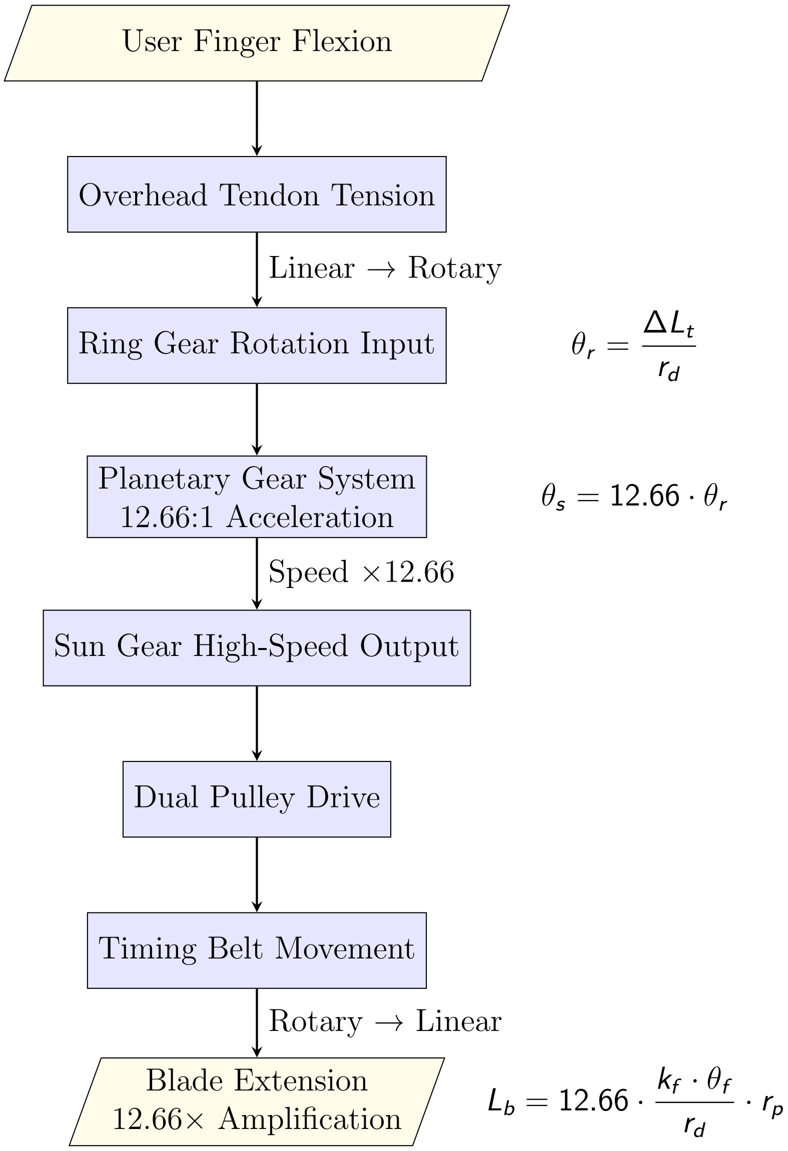
2.1 Drive Method and Transmission

The exoskeleton robotic hand employs an acceleration-based transmission system where finger movements are amplified through a planetary gear mechanism to achieve significant blade extension.

Below is the detailed transmission process illustrated through a flowchart:



2.1.1 Transmission Process Details

1. **Biomechanical Input (Finger Flexion)**:
   - Natural finger flexion creates geometric displacement
   - Overhead tendon routing on finger dorsal side
   - Tendon displacement: $\Delta L_t = k_f \cdot \theta_f$
2. **Tendon to Rotary Conversion**:
   - Tendon wraps around drum connected to ring gear
   - Linear displacement converted to rotational input
   - Ring gear rotation: $\theta_r = \frac{\Delta L_t}{r_d}$
3. **Planetary Gear Acceleration**:
   - Ring gear serves as input (unconventional configuration)
   - Planet gears transfer motion to sun gear
   - 12.66:1 acceleration ratio: $\theta_s = 12.66 \cdot \theta_r$
   - Sun gear outputs high-speed, low-torque rotation
4. **Pulley and Belt Transmission**:
   - Sun gear shaft drives dual synchronized pulleys
   - Timing belts maintain parallel blade alignment
   - Three blades mounted perpendicular between belts
5. **Final Blade Deployment**:
   - Belt movement translates to linear blade extension
   - Total amplification: 12.66× finger movement
   - Final extension: $L_b = 12.66 \cdot \frac{k_f \cdot \theta_f}{r_d} \cdot r_p$

2.1.2 Key Design Advantages

- **Amplification Efficiency**: 12.66× mechanical advantage enables significant blade extension from subtle finger movements
- **Compact Design**: Planetary gear system provides high ratio in minimal space
- **Intuitive Control**: Direct relationship between finger position and blade extension
- **Safety**: Acceleration mechanism requires minimal finger force, reducing user fatigue

2.1.3 Kinematic Performance

The complete transmission system achieves:

$$\text{Overall Ratio} = \underbrace{\frac{k_f}{r_d}}_{\text{Tendon}} \times \underbrace{12.66}_{\text{Planetary}} \times \underbrace{r_p}_{\text{Pulley}} = 12.66 \cdot \frac{k_f \cdot r_p}{r_d} \tag{1}$$

Where small finger movements (θ_f) result in proportionally larger blade extensions (L_b), making the system both responsive and precise for its intended applications.

This acceleration-based transmission represents an innovative approach to exoskeleton tool deployment, leveraging planetary gear mechanics to amplify natural human movements into effective tool operations.

2.2 Fingers and Wrist Mechanisms

2.3 Wolf Claw Mechanism Comparison

2.3.1 Version 1: Planetary Gear

2.3.2 Version 2: Compound Gear Train

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3.1 Fingers and Wrist Modelling

3.2 Wolf Claw Mechanism Version 1: Planetary Gear

3.3 Wolf Claw Mechanism Version 2: Compound Gear Train

4 Conclusion and Future Work

References

[1] author. title. In editor, editor, *booktitle*, year.