

Department of Mechanical Engineering

Engr 466 Design Report 2

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# Introduction

* 1. Current State of the Project
  2. Objectives of this Report

KEEP THINGS CONCISE. GO THROUGH THE DESIGN IN DETAIL BUT ONLY SAY WHAT YOU HAVE TO. SAY IT DIRECTLY AND SIMPLY.

# Final Design Description

The following section outlines the design of a Telecine machine for converting analog 28 mm film to a digital format. The device is made up of a number of design modules which interface with one another to perform the task of cycling through the individual frames on a film reel.

The subsystems of this device are as follows:

* **Film gate**: This device flattens and aligns the film as it passes in front of a digital camera. The component itself is made of two aluminum plates which sandwich the film, forcing it flat. The aluminum plates have a narrow channel for the film to follow, lined with spring-loaded guides to align the film horizontally (preventing sideways drifting of the frames).
* **Film transport mechanism**: The film transport mechanism is what propells the film, pulling it through the film gate. A set of custom-made sprockets were machined to fit the dimensions of the 28 mm film. One of the sprockets is actuated by a stepper motor while the other is free-spinning. The sprockets pull the film by the sprocket holes in the film.

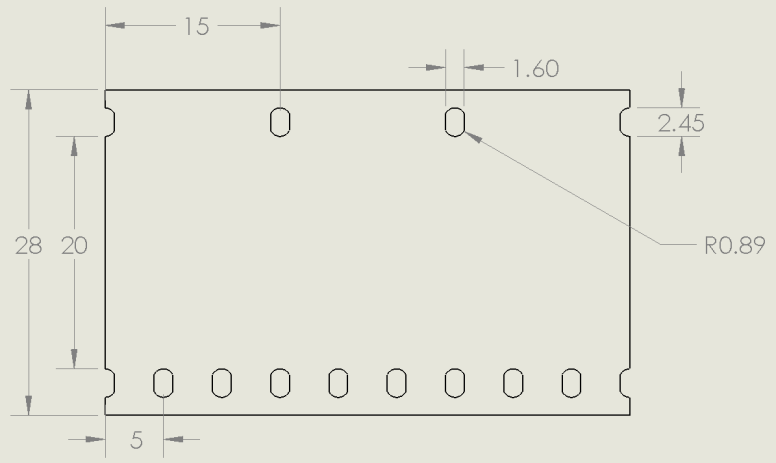


Figure - 28mm Film Segment

The sprockets are fabricated from aluminium and are sandwiched by two aluminium disks for the film to rest on. The sprockets are spaced apart with a delrin spacer of much smaller diameter than the sprockets so the frame of the film is not resting on its surface. The coupler between the sprockets and the stepper motor is also fabricated from delrin.

* **Film Reel Actuation**: The reels of film need to rotate, both feeding film to the sprockets (avoiding unnecessary tension in the film), and spooling up film that has already been imaged on a take-up reel (avoiding a pile of tangled film at the end of the system).

A set of custom-made steel shafts are designed to fit a 28 mm standard film reel. Each of the two shafts (one for out-take, one for up-take) are coupled to a DC motor via a set of aluminum pulleys. The pulley system serves two purposes. One, the ratio of the pulley diameters reduce the speed of rotation from the DC motors; a relatively fast-spinning DC motor can turn the film reels at a slower rate. The ratio of the pulley diameters is approximately 2:1. The other important role that the belted pulley system plays is to allow for slippage. If, for some reason, the film transport sprockets are not moving the film at the same rate as the film reels are rotating, the film will not be providing tension to stall the shaft of the DC motor driving the reel shaft, the belt driving the pulley will slip and provide relief.

As mentioned above, the reel shafts are stainless steel and the pulleys are aluminium. The DC motors are mounted to a piece of 1/8” angle aluminium.

* **Passive Roller Array**: The film is guided from the reels to the sprockets by a set of four delrin rollers. The rollers are free spinning and machined to only contact the film on the edges, in order to prevent unnecessary friction forces on the film. The rollers spin on stainless steel shafts and are sandwiched by two delrin washers.
* **Film Tension Monitor**: Should the tension in the film become too high, a monitoring system will alert the actuators moving the film and act to remedy the problem. One of the passive rollers mentioned above is fixed to the end of an aluminum lever-arm which pivots about the knob of a potentiometer. As the tension in the film increases, the roller will deflect and rotate the knob of the potentiometer, creating an analog output which can be measured and translated into a digital quantity of the tension of the film. The lever-arm is attached to a spring so that, as the tension is reduced, the arm rotates back to the zero-displacement position.
* **LED Frame Illumination Device**:
* **Camera Mount**:

In summary, the combined action of the above-described subsystems is as follows: The DC motor driving the out-take film reel feeds film through an array of passive rollers which guide the film to a set of sprockets, which rigidly fix and actuate the film through the film gate (positioned between the two sprockets). The film then passes through another set of rollers and is rolled onto an up-take reel driven by another DC motor. As each frame passes through the film gate, it is framed and illuminated by a light source and then captured by a digital camera mounted above the film gate. The tension in the line is monitored by a spring-loaded roller which deflects as the tension increases.

# Detailed Mechanical Overview

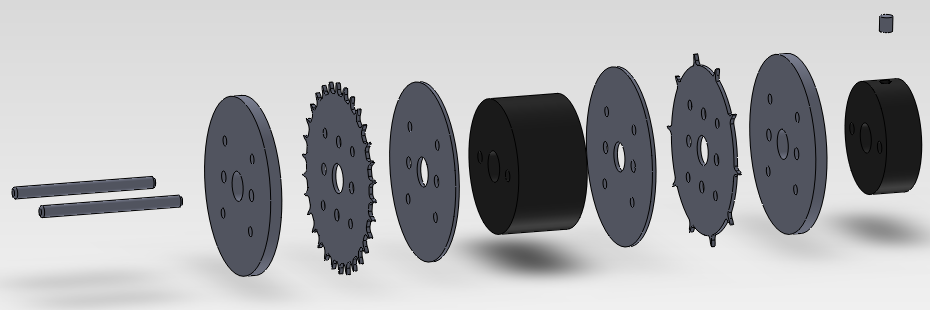
* 1. Film Transport Mechanism

|  |  |
| --- | --- |
|  |  |

* + 1. Specifications

-description and function

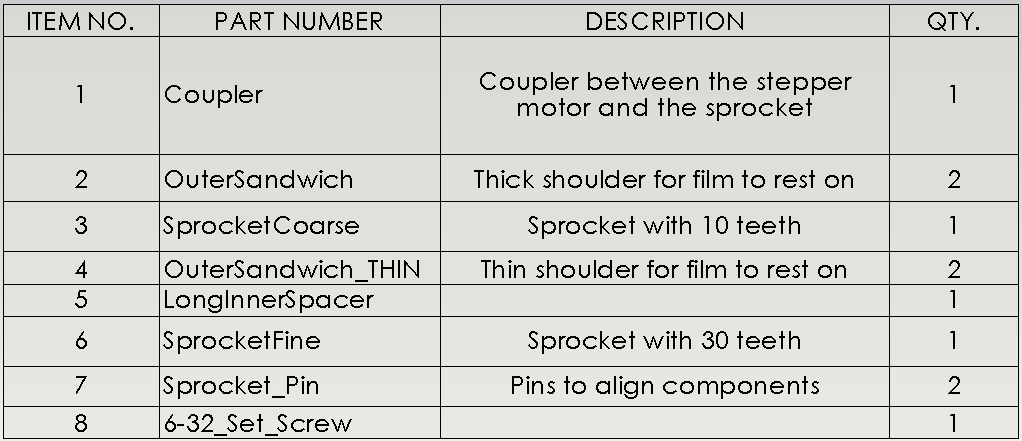
-exploded drawing



-components, material, interfacing actuators

-fasteners

-drawings



* + 1. Failure Modes

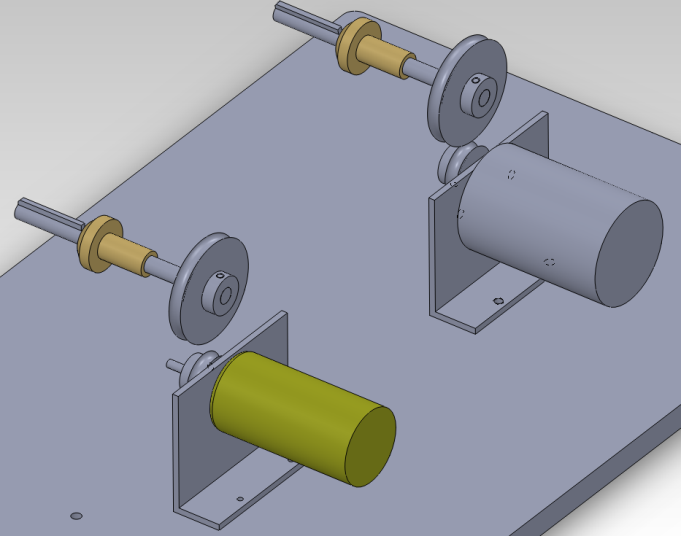
-periodic shaft loading

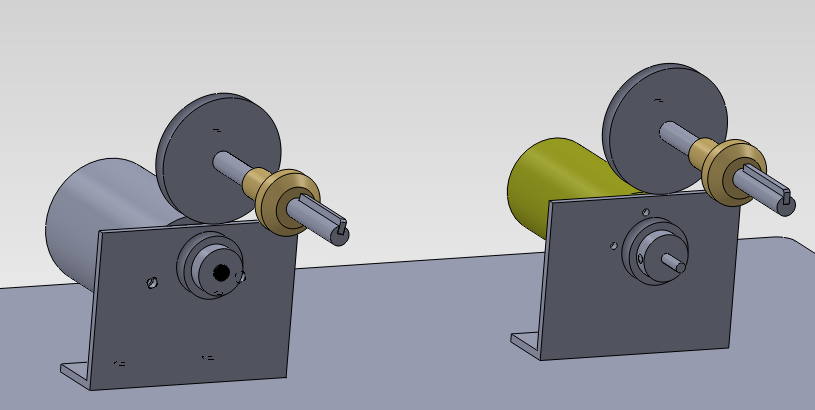
-static shaft loading from its own weight

* + 1. Comments

How could it be better? Why it might be overdone?

* 1. Film Reel Up-take and Out-take





* + 1. Specifications

-description and function

-components, material, interfacing actuators

-fasteners

|  |  |
| --- | --- |
|  |  |

-drawings



* + 1. Failure Modes

-periodic shaft loading

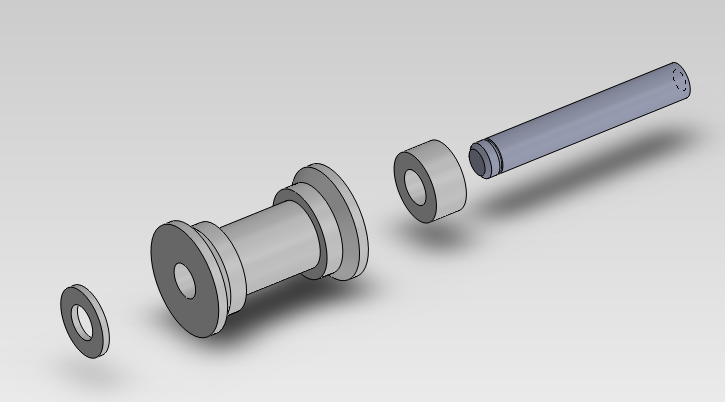
-static shaft loading from its own weight

* + 1. Comments
  1. Roller Array

|  |  |
| --- | --- |
|  |  |

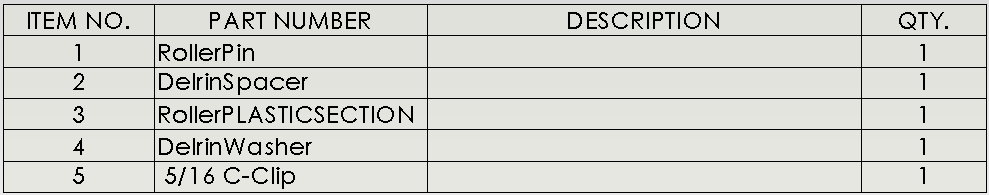
* + 1. Specifications

-description and function



-components, material, interfacing actuators

-fasteners



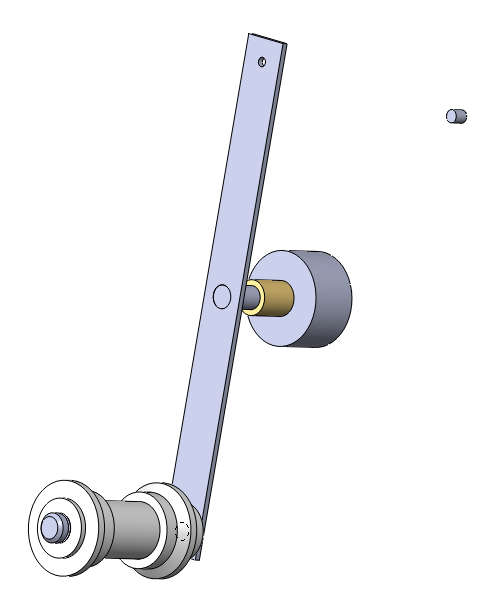
-drawings

* + 1. Failure Modes

-periodic shaft loading

-static shaft loading from its own weight

* + 1. Comments
  1. Film Tension Monitor



* + 1. Specifications

-description and function

-components, material, interfacing actuators

-fasteners

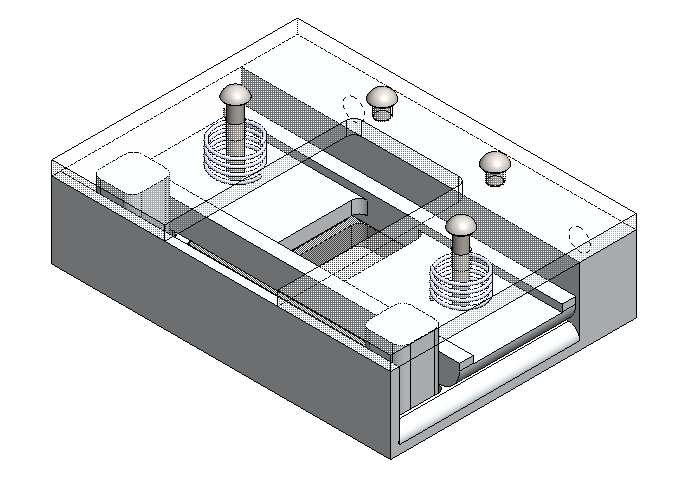
-drawings

* + 1. Failure Modes

-periodic shaft loading

-static shaft loading from its own weight

* 1. Film Gate



* + 1. Specifications

-description and function

The purpose of the film gate is to align and straighten the film as each frame passes by for capture by the camera.

-components, material, interfacing actuators

-fasteners

-drawings

* + 1. Failure Modes

-periodic shaft loading

-static shaft loading from its own weight

* + 1. Comments
  1. System Frame

The system frame supports and aligns the mechanical components of this telecine device.

* + 1. Specifications

-description and function

-components, material, interfacing actuators

-fasteners

-drawings

* + 1. Failure Modes

-periodic shaft loading

-static shaft loading from its own weight

* + 1. Comments

# Design Component Interfacing

…the mechanical interfacing.. spacing between film gate and sprockets.. how things are layed out on the frame ex, so the tensioner will fit and operate. (basically a detailed discussion of the frame)

Identify all the interface circuits

Identify the software relationships between

# System Assembly Overview

# Electrical Design

-individual circuits and the power requirements, operating parameters for our actuators/sensors

-giant system circuit

# Preliminary Software Design

The implementation of the software control system is aimed for simplicity and robustness. Since the main project objective is only focused on capturing film, most of the microcontroller’s resources will execute the operations one at a time. The preliminary software design for this project is displayed in FIGURE and TABLE.

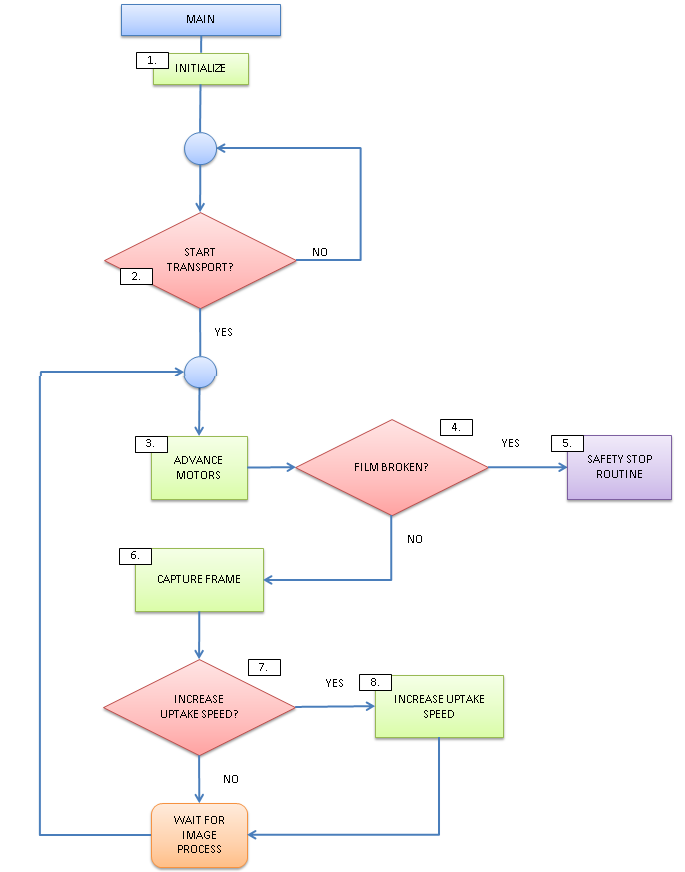


Figure – Software design flowchart

|  |  |
| --- | --- |
| **Ref** | **Description** |
| 1 | Initialization for the control system. This is where the rotational speeds for the motors are first set, along with the manual adjustments so that the frame matches with the film gate hole. |
| 2 | This is a confirmation for the user to start the film transport operation. The trigger for this event will be a push button input of some sort. Otherwise, the program will wait until the user is ready. |
| 3 | The motors advance the film forward by one frame. This means the stepper motor and the driving film motors will all move. |
| 4 | This is where the optical sensors will try to detect a discontinuation in the film. |
| 5 | This routine is accessed if there is a discontinuation in the film. It could mean that the film has been broken or the film wheel has reached the end of the movie. Either way, the whole system must stop. The micro-controller will power down everything to conserve power. |
| 6 | If everything goes well in the film advancement, a signal will be sent to the camera to capture the frame on the film. |
| 7 | Optical sensors will check the thickness left in the film wheel and decide if the motors require a change in speed. |
| 8 | Changes in motor speed are requested so it will be adjusted accordingly. Afterwards it will wait for the camera to finish processing the image before repeating the entire film capturing process. |

# Conclusions

-current challenges we are facing and how we are attacking it.

-our next steps

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