# Film Scanning System (FSS)

Max Widjaja - widjajm@wwu.edu – (425) 260-2928

WESTERN WASHINGTON UNIVERSITY
MAKE WAVES.

## Abstract

The Film Scanning System is an electronic and mechanical system which automates the film scanning process. This system consists of a light sensor array to detect each exposure frame, a motor which advances the film through the holder, and an automatic trigger for the camera.

Automation reduces the time it takes to scan a roll of 35mm film by over half, while delivering more consistent results. The FSS aims to bring an affordable automatic scanning option for film photography enthusiasts.

At the time of writing, there are few devices that perform the function of the FSS, and they are often prohibitively expensive.

## Equipment Used

**Selected Components:**

**MCU:** LPC802
- RAM/ROM: 2KB/16KB

**Light Sensor:** TI OPT3004
- I2C Communication
- Variable addresses

**Stepper Motor Driver:** Allegro A4988
- Breakout Board implementation on PCB

**Buck Regulator:** AP63203
- Fixed 3.3V Output for $V_{DD}$

**Software:**

**Revision Control:**
**Gitlab**

**Firmware Development:**
**MCUXpresso v24.12.148**

**PCB Design:**
**KiCad 9.0**

**Hardware:**

- Oscilloscope
  - Verification and Prototyping
- Multimeter
  - Verification and Prototyping
- DC Power Supply
- Function Generator

*Developed 35mm Film, to be scanned*

## Challenges Encountered

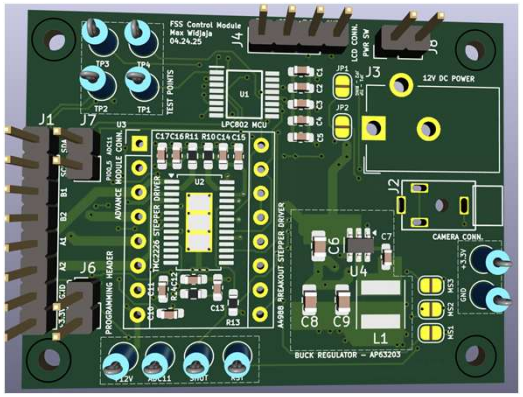
**Underequipped MCU:** The Microcontroller chosen for the project while theoretically more than capable for the scope of the firmware, considerably hindered development.
- Low RAM and ROM eliminated the possibility for using a Real-Time OS.
- Low amount of GPIO pins forced using the ADC as a form of user input.

**Failure to Program PCB:** One month before demo day, the FSS board lost the ability to be programmed. Multiple programmers (via Segger J-Link), and multiple FSS boards were tested, but neither fixed the problem. It is believe to be a hardware issue.
Due to the looming deadline, the decision was made to implement the FSS on the LPCXpresso802 development board.

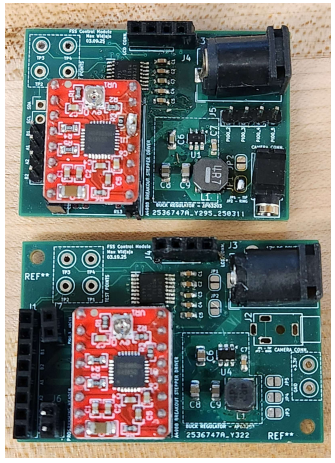
## References

## Results

Unfortunately, the **Film Scanning System** is wholistically not functional. However, the following features were accomplished:
- Stepper Motor control on PCB level
- MCU Programming on PCB level
- Camera Shutter on PCB level
- Buck Converter on PCB level
- I2C Communication on Arduino (proof of concept)




*The final FSS PCB, rendered in KiCad*



*Prototype boards, v1 and v2 (top and bottom)*

## Future Direction

While the FSS was not functional, it was a valuable learning experience for electronic design. The lessons learned from the FSS could likely yield a successful second attempt at the FSS.

What needs to change for a successful FSS v2.0:
- A more capable MCU with more memory, as well as more online resources. The LPC802 is not a commonly used MCU by any measure.
- More time invested into I2C prototyping on the hardware level.

What was successful/can be reused:
- The PCB design was successful. The only changes required for the PCB would be in regards to any components (MCU, light sensors, or otherwise) that need to be switched.

## Acknowledgements

Special thanks to:
John Lund and Todd Morton