Heads-Up Display for Microscopic Assembly

MAY 1607

Authors:

Noah Bergman, Garrett Hembry,
Mike Kelly, Greg Kuhn

Task Responsibility

Team Leader - Noah Bergman

Web Master - Garrett Hembry

Key Concept Holder - Michael Kelly

Progress Reporter - Gregory Kuhn

Advisor – Dr. Jaeyoun Kim

Client – Bob Dearth

Background

During the assembly of miniature mechanisms, Honeywell technicians face repetitive movements and eye strain to check work instructions which are displayed on a nearby computer monitor.

Kansas State senior design group identified a heads-up display in the microscope would reduce eyestrain and manufacturing time during assembly.

Alternatives

1. Wall mounted monitor - A monitor attached to a monitor arm, attached to a pole.
2. Microscope Mounted Tablet - Tablet attached to microscope reduces turn time operator.
3. Surgical Microscope - Cost(8,000.00-35,000.00), Bulky, Task Specific.
4. Other technology - Augmented reality glasses, Google Glass

Project Statement

Optically insert a virtual screen inside the microscope's field-of-view to reduce eye strain and operator movement during the assembly process.

Requirements

- Easy to Use, Good Resolution
- View and interact with PDFs, Pictures, and Videos
- Does not compromise associate’s field-of-view
- Does not obstruct airflow in the work area

Constraints

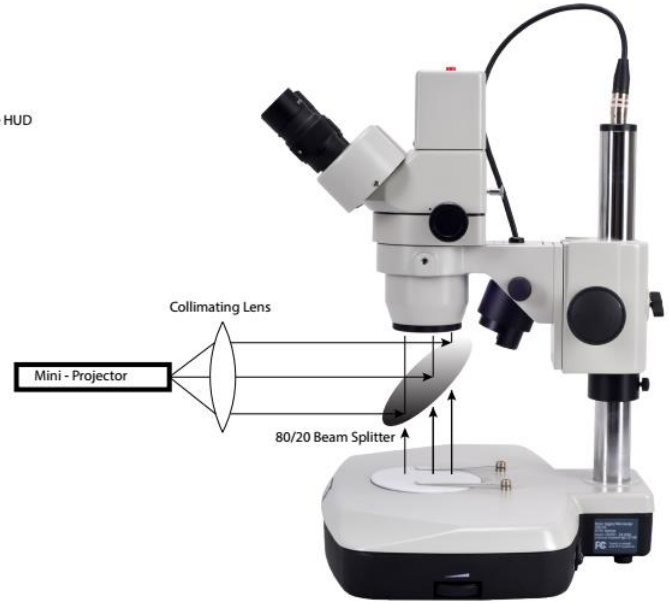
- 15” vertical workspace height
- Retroactively fit new optics on a microscope without excessive modifications
- Remains in focus during normal microscope operation

Initial Research

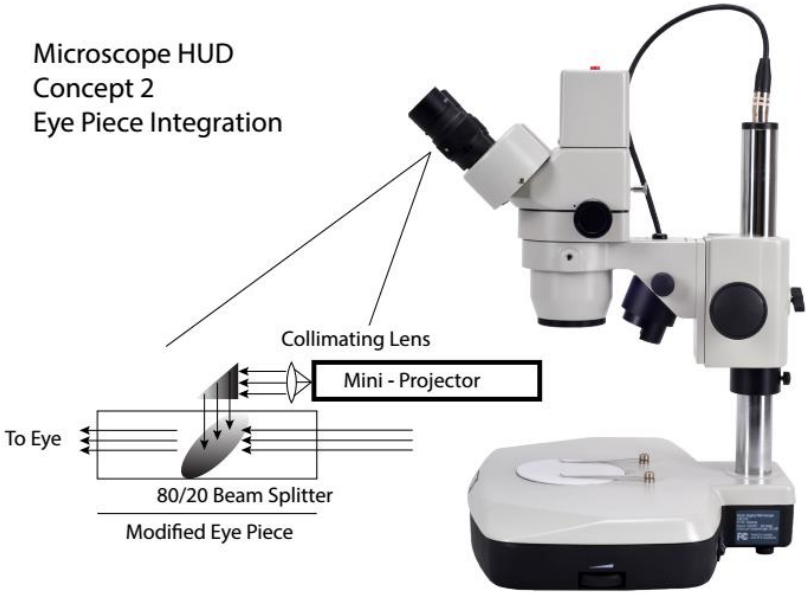
- Developed our understanding of the microscope system
- Disassembled a pico projector
- Explored various beam splitter and other optical arrangements

Original concept Drawing

Microscope HUD
Concept 1

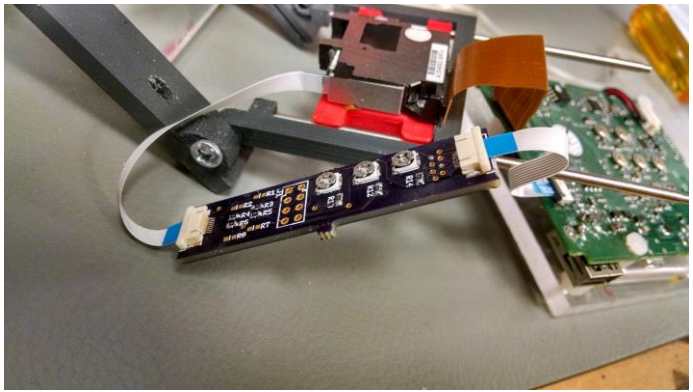


Microscope HUD
Concept 2
Eye Piece Integration



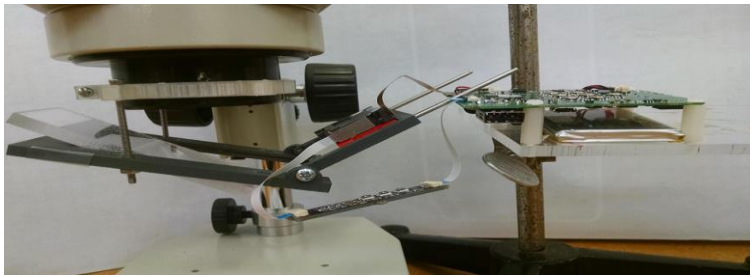
First Integration Concept

- Implemented manual brightness adjustment
- Reverse-engineered projection system
- Tested the internal optical arrangement

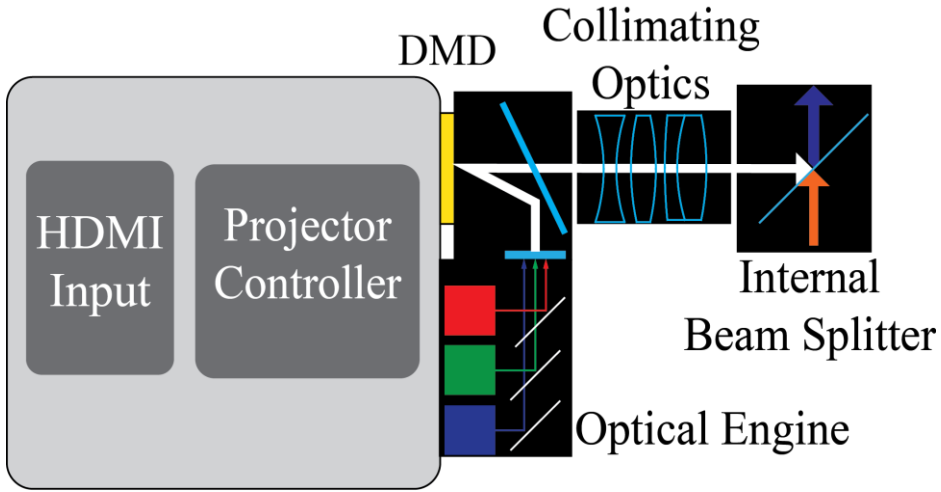


First Integration Concept

- Image reflected from underneath objective lens
- Universal application
- Obstructed the workspace
- Does not remain in focus

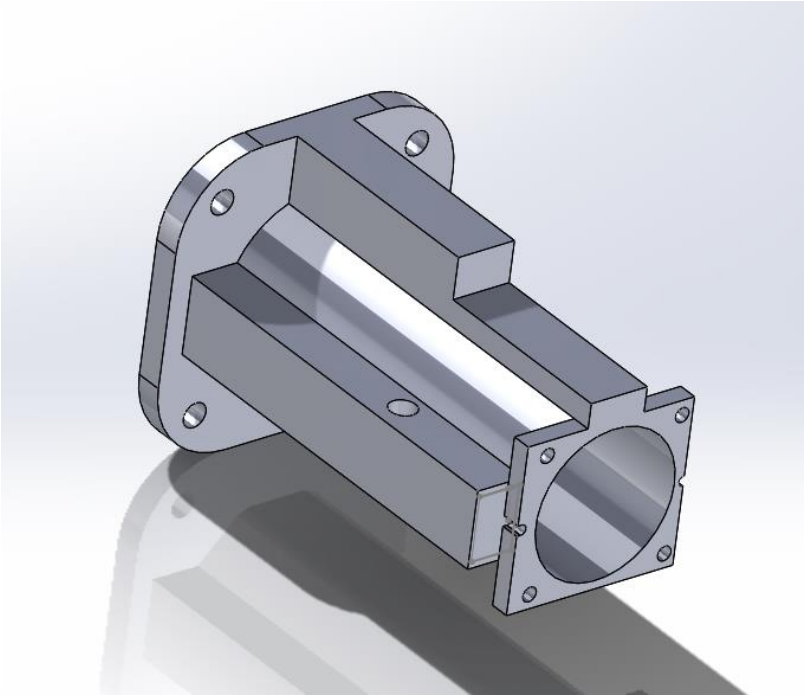


Revised Concept Drawing



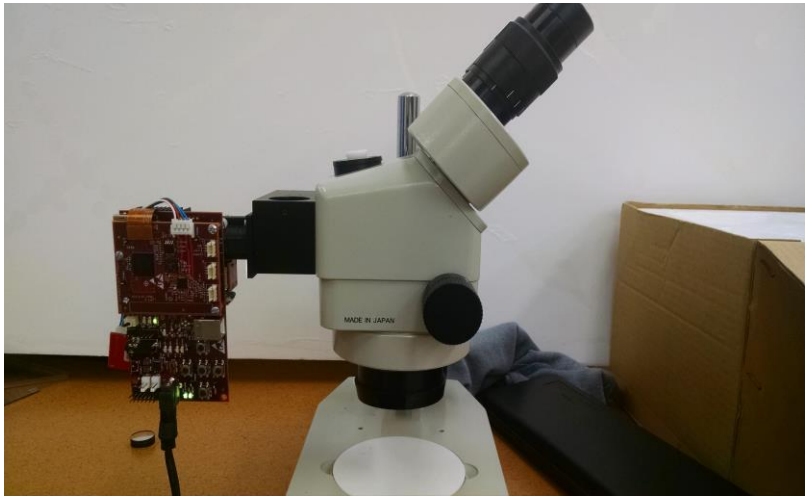
Optical Integration

- Designing custom mounting bracket to integrate the projector, optical system, and microscope
- Tested feasibility of integrating the projector into the camera port of the microscope



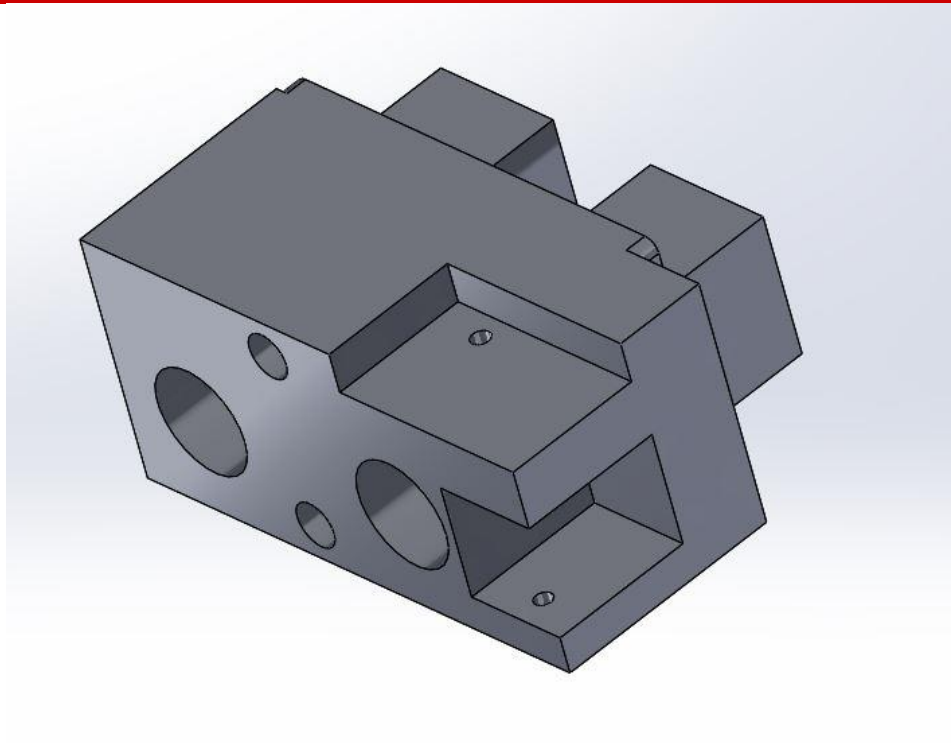
Testing Camera Port Integration

- Modified the camera port of the microscope to project into the system
- Image remained in focus and was unobtrusive

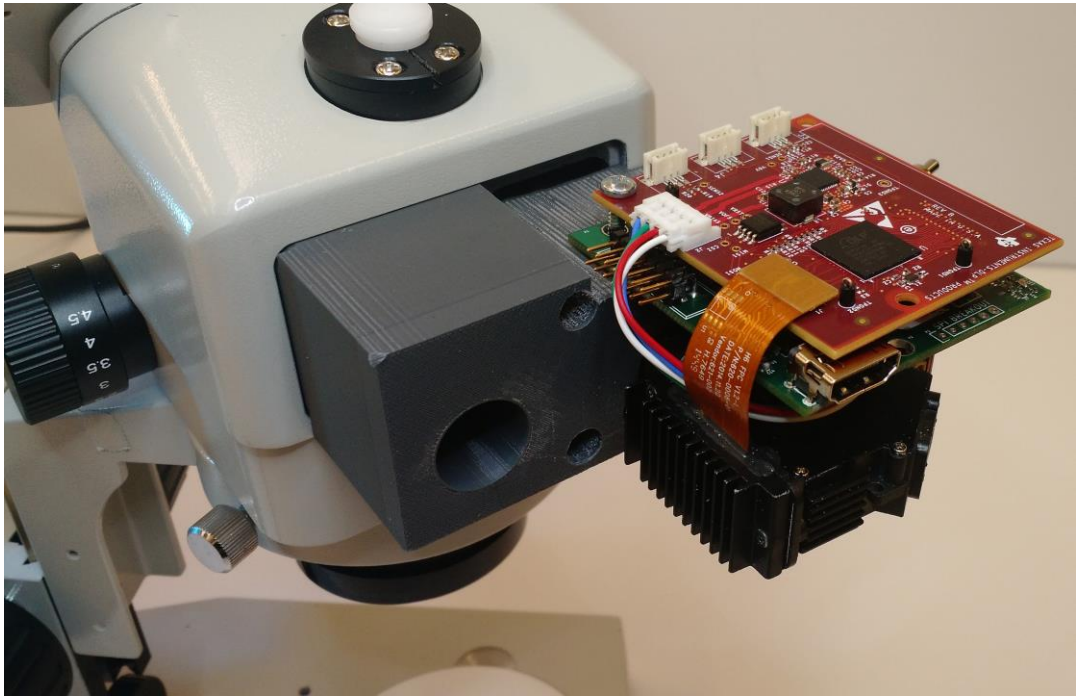


Optical Integration

- Unobtrusive design
- Aligns all the optics correctly with minimal deflection
- Supports entire system
- Designed around existing camera port

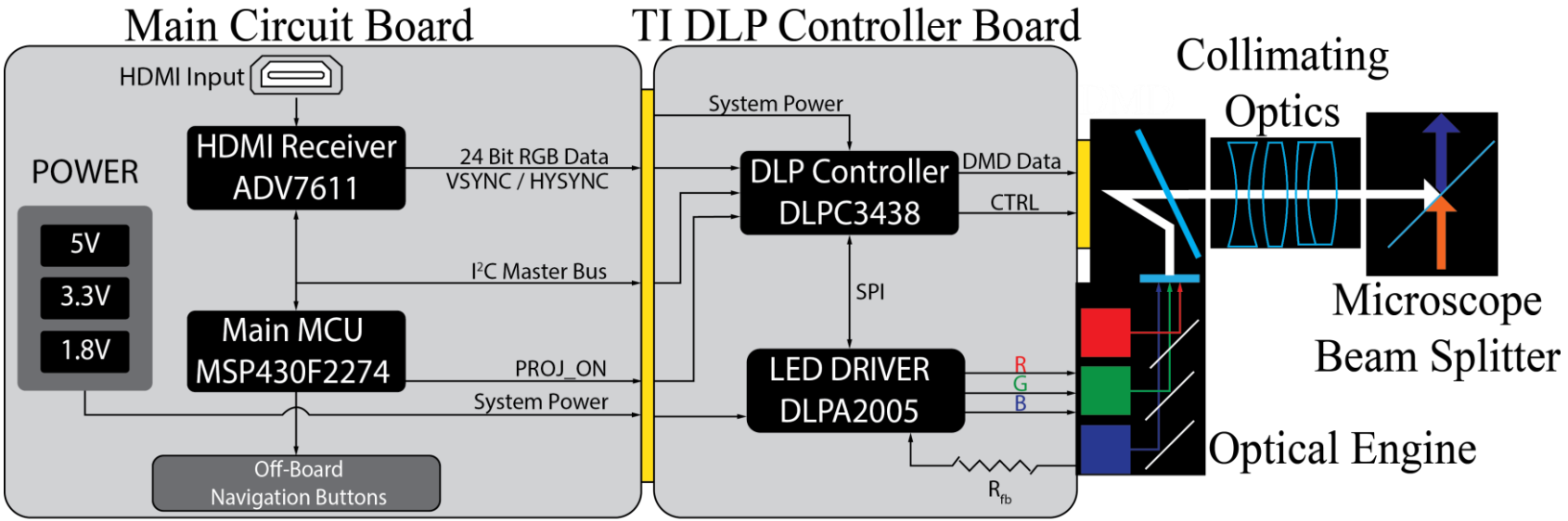


Final Design



System Design

Functional Decomposition

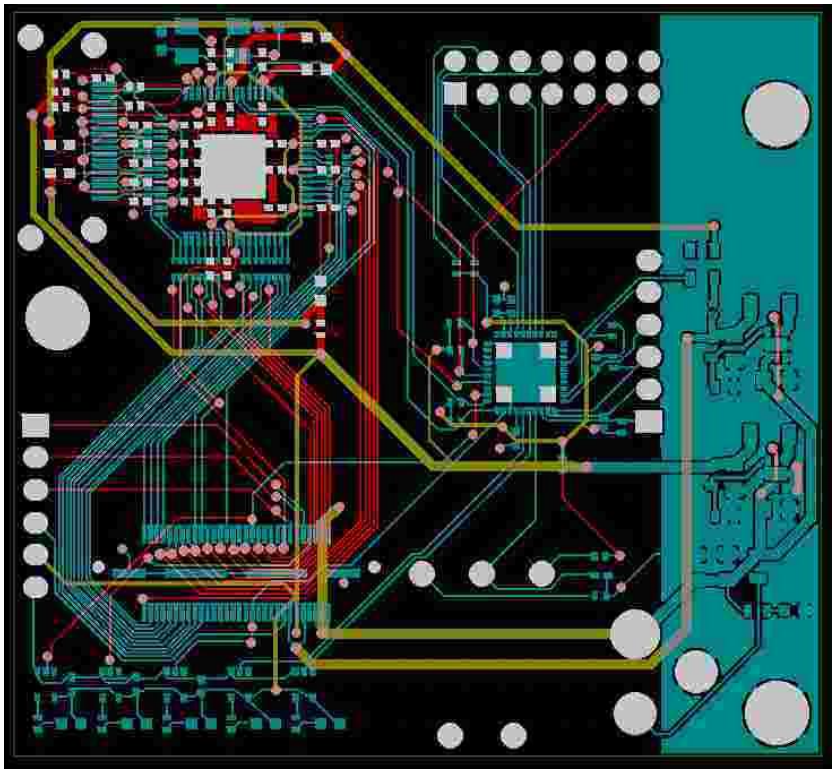


Honeywell

Main Circuit Board

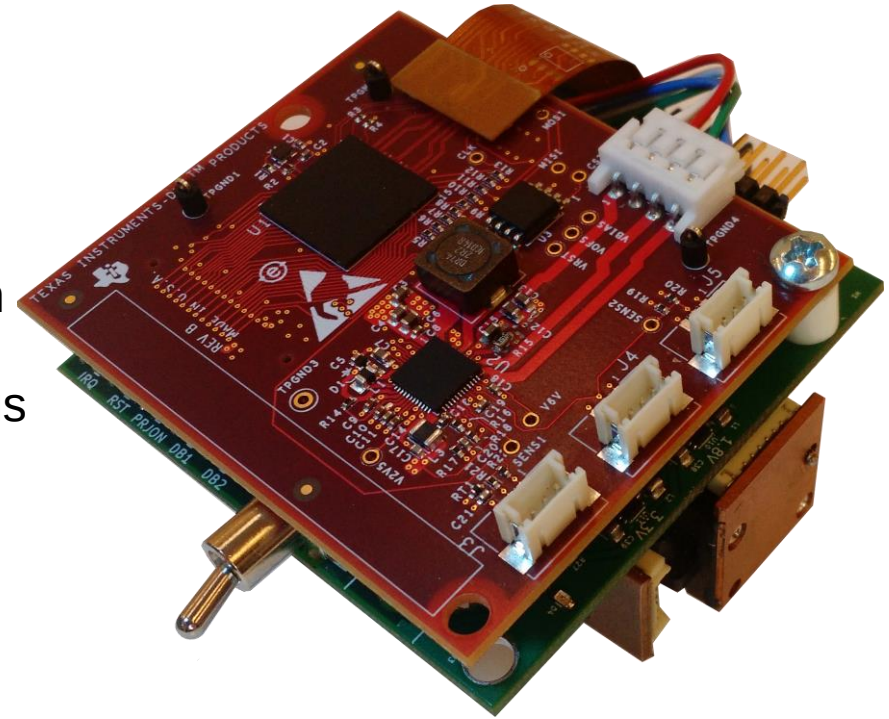
- Integrate with TI DLP Driver board
- HDMI receiver to 24 bit RGB
- Coordinates all systems on board using I^2C
- Manages power distribution for on-board IC’s

Main Circuit Board



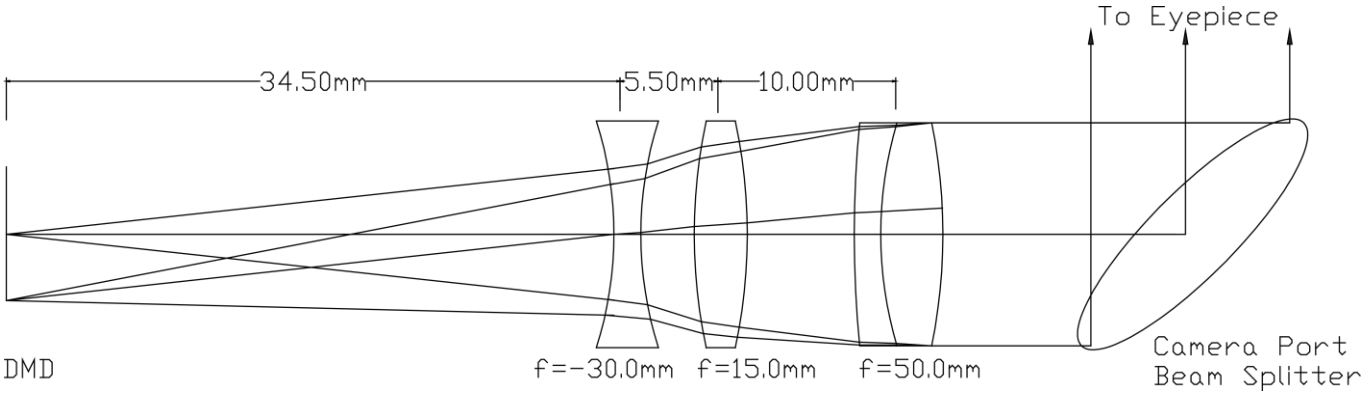
DLP Controller Board

- Controls Digital Micro-mirror Device
- Regulates LED current and illumination
- Image manipulation and display settings



Optics Design

- Bi-Concave: produces a virtual image within focal length of second lens
- Bi-Convex: tunes the focal length and magnification of image
- Achromatic: collimates the image and corrects for color aberration

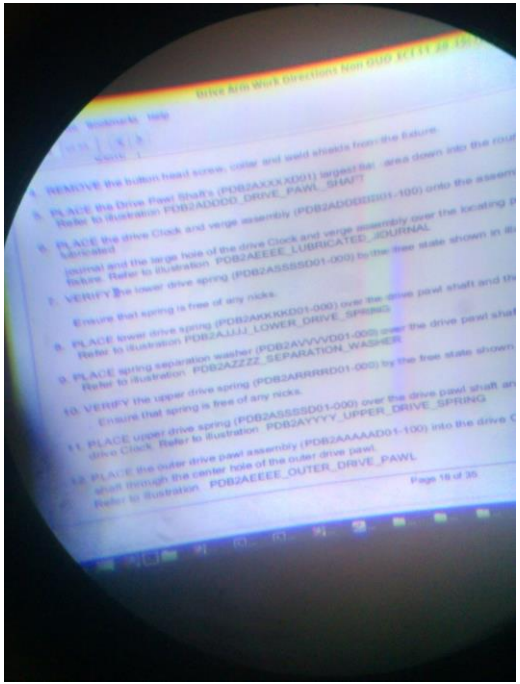


Project Status

Test Methods

Work Instructions for Nano Blocks

Lego Bricks



Plan Information

Kansas City Plant
National Security Asset

Part No	Plan Title	Plan Rev	Plan Type	Rtg Code
123456-00-ME	Drive Clock Assembly	5	PR	01

Oper No		Oper Title	Alt Oper No	Work Location	Work Dept	Work Center
340	Cont.	Assemble		FMT	MII	MIIG641

4. REMOVE the button head screw, collar and weld shields from the fixture.

5. PLACE the Drive Pawl Shaft's (PDB2AXXXXD01) largest flat area down into the round recess of the fixture base. Refer to illustration PDB2ADDDD_DRIVE_PAWL_SHAFT

6. PLACE the drive Clock and verge assembly (PDB2ADDDDD01-100) onto the assembly fixture with the drive pawl shaft through the lubricated

   journal and the large hole of the drive Clock and verge assembly over the locating pin on the fixture. Refer to illustration PDB2AEEEE_LUBRICATED_JOURNAL

7. VERIFY the lower drive spring (PDB2ASSSSD01-000) by the free state shown in illustration PDB2APPPP_LOWER_DRIVE_SPRING_

   Ensure that spring is free of any nicks.

Honeywell

Recommendations

This project is prepared for continuation in the upcoming semester.

We recommend a more software oriented team in order to:

Computer Integration – Control PDF through microscope interface

Embedded Firmware - HDMI and projector configuration

Hardware Improvement – Modifications to existing setup

Resources and Cost Estimate

Part	P/N	Cost
Circuit Board	-	$66.00
DLP EVM	DLP3010 EVM	$300.00
DMD Controller	DLPC3438	$34.77
HDMI RX	ADV7611	$14.21
Main MCU	MSP430F2274	$6.43
Misc. Components	N/A	$30.90
	Total	$452.31

Thank You

Bob Dearth

Dr. Jaeyoun Kim

Lee Harker

Dr. George Amariucai

Senior Design Panel

Questions ?