According to the World Health Organization, more than 35 million people were living with human immunodeficiency virus (HIV) in developing countries by 2005. Global health initiatives emphasize the urgent need for affordable and effective technologies to obtain CD4 counts in resource-poor areas in order to identify patients, monitor disease progression, determine treatment regimen, and track patient response.

In developed countries, CD4 counts are obtained by flow cytometry, which requires large capital investment, skilled technicians, and reliable infrastructure. Limited clinical access in developing countries inhibits treatment efficiency, burdens the patient, and prevents effective distribution of resources. A successful device would measure low CD4 cell counts accurately, cheaply, quickly, and require low technical expertise to operate.

Inspired by global HIV treatment initiatives, alternative technologies are emerging for accurate, low-cost diagnostic assays. Among these, miniaturized point-of-care instruments promise a viable alternative to current equivalents such as flow cytometry. This project aims to prototype a novel diagnostic platform to acquire CD4 counts while meeting the design limitations of low-resource settings.

**Methodology**

- Conversion of DC electric pump to hand-cranked mechanical pump
- Integration of microfluidic platform with camera and pumps
- Concentration of whole blood cells in whole blood samples
- Conjugation of anti-CD4 antibodies to fluorescent europium nanoparticles
- Fluorescent antibody labeling of CD4 cells
- Digital image acquisition and analysis
- Quantification of CD4 cell counts per microliter of a blood sample

**Device Components**

1. Stepper Motor
2. Alignment Screws
3. Shaft Coupler
4. Fluid Tubing
5. PDSM Washer
6. Thermal Reactor
7. PDSM Device
8. Polyimide Tape

**Problem Statement**

Design Objectives

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- Integration of microfluidic platform with camera and pumps
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**Cell Trap Filter Array**

**Peristaltic Pump & Mixer**

- Stepper Motor
- Alignment Screws
- Shaft Coupler
- Fluid Tubing
- PDSM Washer
- Thermal Reactor
- PDSM Device
- Polyimide Tape

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The number of trapped CD4 cells increases over time from 1 to 2 to 4, supporting that the number of trapped CD4 cells will continue to increase as the whole blood is recirculated through the device.

**Identification of CD4+ cells in whole blood on chip**

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**Conclusion**

- Production of a hand crankable device: the pump is operated with no electrical power.
- The hand-crank mechanism allows the pump to be operated with no electrical power. The device is composed of inlet ports, minor elements, and the circular array of channels that comprise the PDSM portion of the pump.

**Reference**

