Waste disposal is becoming an ever greater concern in our modern world, and very little recyclable waste is ever ultimately recycled. We propose Scrapsort, an autonomous system that can sort trash on-site immediately.

Scrapsort operates in three stages as objects move along a conveyor belt:
- **Detection**: ultrasonic sensors detect objects
- **Classification**: MAX78000 microcontroller has an onboard camera & CNN hardware accelerator to classify objects.
- **Sorting**: stepper motors activate to push objects into bins when they arrive at their destination

**Hardware**
- 120VAC Wall Socket
- 120VAC → 36VDC Power Supply
- 5V Buck Regulator
- CNN Accelerator
- OV9692-RYAA Camera
- MAX78000 FTHR
- SPI
- GPIO
- Stepper Motor
- Binning Arm

**Software**
- When an event happens, an interrupt triggers and pushes a task onto a queue
- Tasks are handled in the main loop which constantly checks for items on the task queue
- Tasks are prioritized by the order (in time) of occurrence

**Overview**
- **Detection**
- **Classification**
- **Sorting**

**Item Queuing**
- Classification result pushed onto queues for sorting
- Items popped off queues as they move past arms

**Sorting Control Flow**
- **Item Placement and Classification**
  - Ultrasonic sensor triggers camera to capture image
  - Image passed into CNN model for classification

**Item Queuing**
- Classification result pushed onto queues for sorting
- Items popped off queues as they move past arms

**Sorting Arm**
- Arms swing open when corresponding item arrives
- Arms close and push item into mounted bins
- Custom motor profiles for opening and closing to balance speed and torque

**Machine Learning**
- CNN Architecture
  - 10 Convolution Layers (147,096 weights)
  - 2 Fully Connected Layers (151,712 weights)
  - Total: 278 KB ~ 85% weight memory
  - Inference Time: 13.5 ms

**Full System**
- Stepper motor
- Ultrasonic distance sensor

Acknowledgements:
Special thanks to Analog Devices, Brian Rush, Yogananda Isukapalli, B.S. Manjunath, Satish Kumar, Brycen Westgarth, and Chris Cheney