One Image: Exploring Open Source Digital Imaging for Research

Eva Kevei

e.g.kevei@reading.ac.uk
Aims

• 1-year,
• cross-campus and cross-disciplinary,
• open research program
• to develop inexpensive, accessible, digital imaging research instrumentation built on the Raspberry Pi platform:
  • controllable, high quality, digital imaging of research targets and objects
Why?

• Need for low-cost high-throughput imaging of various subjects

• Consumer digital cameras – can deliver great quality, but less controlled imaging conditions

• Laboratory cameras - fully controlled to capture consistent, precise images but expensive (specialist research markets)

• Raspberry Pi is an easy-to-use single-board computer and cheap

• Raspberry Pi cameras can be high performance and are compatible with high-quality microscope lenses

• Compact system with small footprint in the lab or adapted to field work

• A large number of available tools/codes developed that can be easily adapted to the specific requirements
Local users

Research subjects (direct users):

*C. elegans* (Kevei lab)

Zebrafish (Pollitt lab)

Bacteria (Barrett lab)

Mice (Vasudevan and Maiaru lab)

Platelet (Jones lab)

*In gel* chemical oscillations (Hayashi lab)

Historical prints (Dr Lickiss)
Direct outcomes – affordable imaging system with design shared open source

- Easy to create
- Easy to use
- Affordable
- Multipurpose
- Modular
- For research, teaching and outreach
- Interdisciplinary collaborations across the campus
The team

- Al Edwards
  - Sarah Needs
  - Ruya Meltem Sariyer
- Eva Kevei
  - Susanna Cogo
- Alice Pollitt
- Glyn Barrett
- And more...
- Steven Wasko
- Ross Wilson
- 3 PhD students part time - preliminary research studies for bigger grant applications

Design
Test
Validate
Publish

Technical support
Research into genetics of Parkinson’s disease

- Motor symptoms:
  - Resting tremor
  - Bradykinesia
  - Postural instability
  - Muscle rigidity

- Non-motor symptoms:
  - Sleep disturbances
  - Loss of olfaction
  - Cognitive impairment
  - Constipation, etc.

Degeneration of dopaminergic neurons in the SNpc
Research into genetics of Parkinson’s disease
Build some multipurpose modular system

Multiple static camera (6-8) on a fixed frame with camera (lenses attached) being moved in vertical direction for manual focusing

One camera on frame moving above 6-10 samples/image positions, which are monitored over longer time; camera can be moved in vertical direction for manual focusing

**IMAGES**
- Images taken every 1-30 minutes for 1h up to 10 days
- Image quality: highest possible resolution with smallest (3-5 mm) to highest (35-100 mm) field of view

**SHORT VIDEOS**
- Short videos 20sec
  - 20 sec videos, manual/programme controlled start, automatic switch off when 20 sec done (having flexibility to set it for longer or shorter video length is essential)
  - Possibility to take many (hundred?) videos without need to transfer data (USB stick with larger memory to save the videos on)
  - Video quality: minimum ?? And FPS

**VIDEOS**
- Long videos 30 minutes
  - 30 minutes videos, manual/programme controlled start, automatic switch off when 30 min done (having flexibility to set it for longer or shorter video length is essential)
  - Possibility to take many (10-20?) videos without need to transfer data (USB stick with larger memory to save the videos on)
  - Video quality: minimum ?? And FPS

**IMAGES/SHORT VIDEOS**
- One camera moves in X/Y (horizontally) over/between fixed image/sample positions
- Images taken every 5-60 minutes for 1h up to 10 days
- Alternatively, videos taken every 10-60 minutes for 4h up to 72h
- Image quality: highest possible resolution with smallest (3-5 mm) to highest (35-100 mm) field of view
- Video quality: minimum?? and FPS
Next steps

- AI for pattern recognition to automatize analysis and description of motility
- Modelling movement behaviour
- Zuowei Wang - Mathematics
- Hong Wei – Computer Science
- Nandini Vasudevan – SBS
- Xingchen Zhai

Impact of microplastics on social behaviours
Open Source

- Sharing open hardware design – Open source hardware journals
- Sharing code - GitHub or Google Code