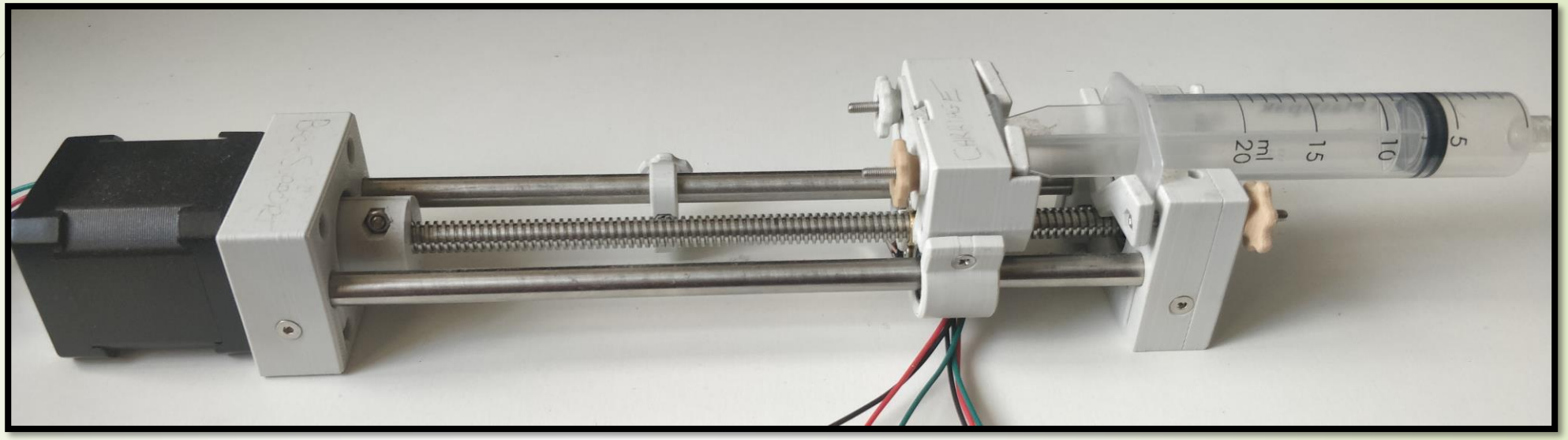


Pumpy
Design and Manufacture of a Syringe Pump

Daniel Woolsey

Contents

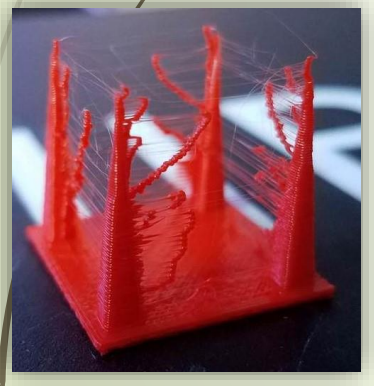
- Project Goals
- Development, Design and Manufacturing
  - Using a 3D Printer
  - Designing and Building a Syringe Pump
  - Creating a GUI
  - Building an Android Application
- Demonstration
- Project Planning
- Conclusions and Future Work

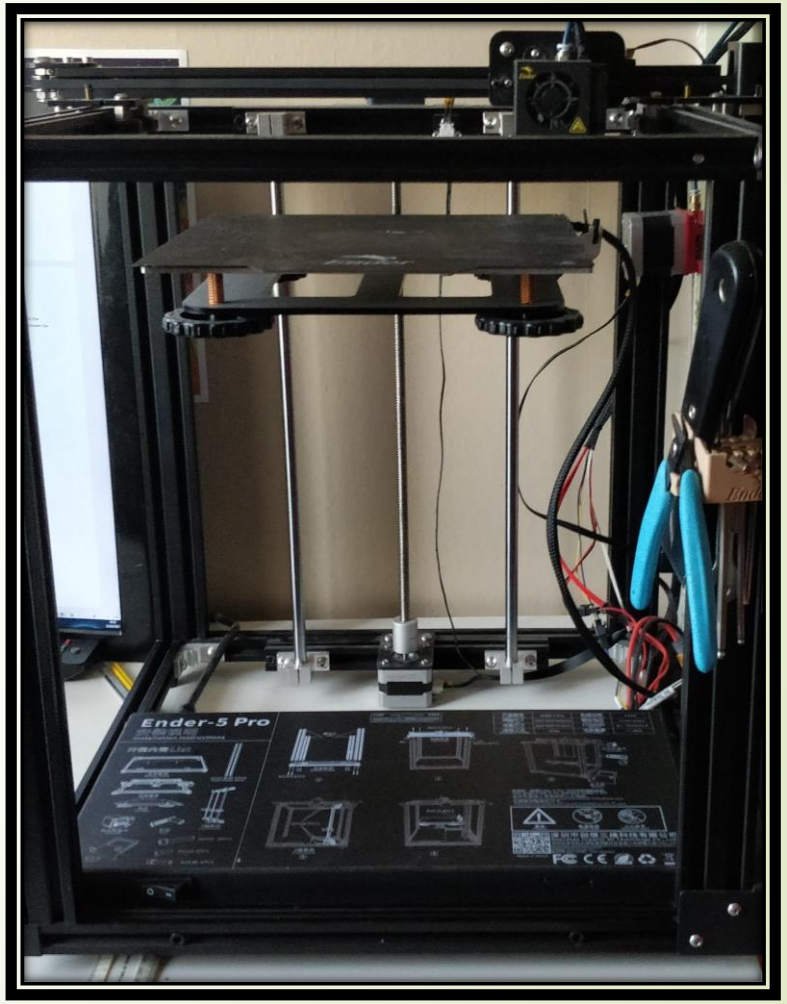
Project Goals

- Analyze, Build and Test an Open-Source Syringe Pump
- Modify and Improve the hardware
- Design a GUI for user friendly operation
- Create a mobile application for remote operation
- Explore the viability of a cheap and open-source medical Syringe Pump

Development, Design and Manufacturing Using a 3D Printer

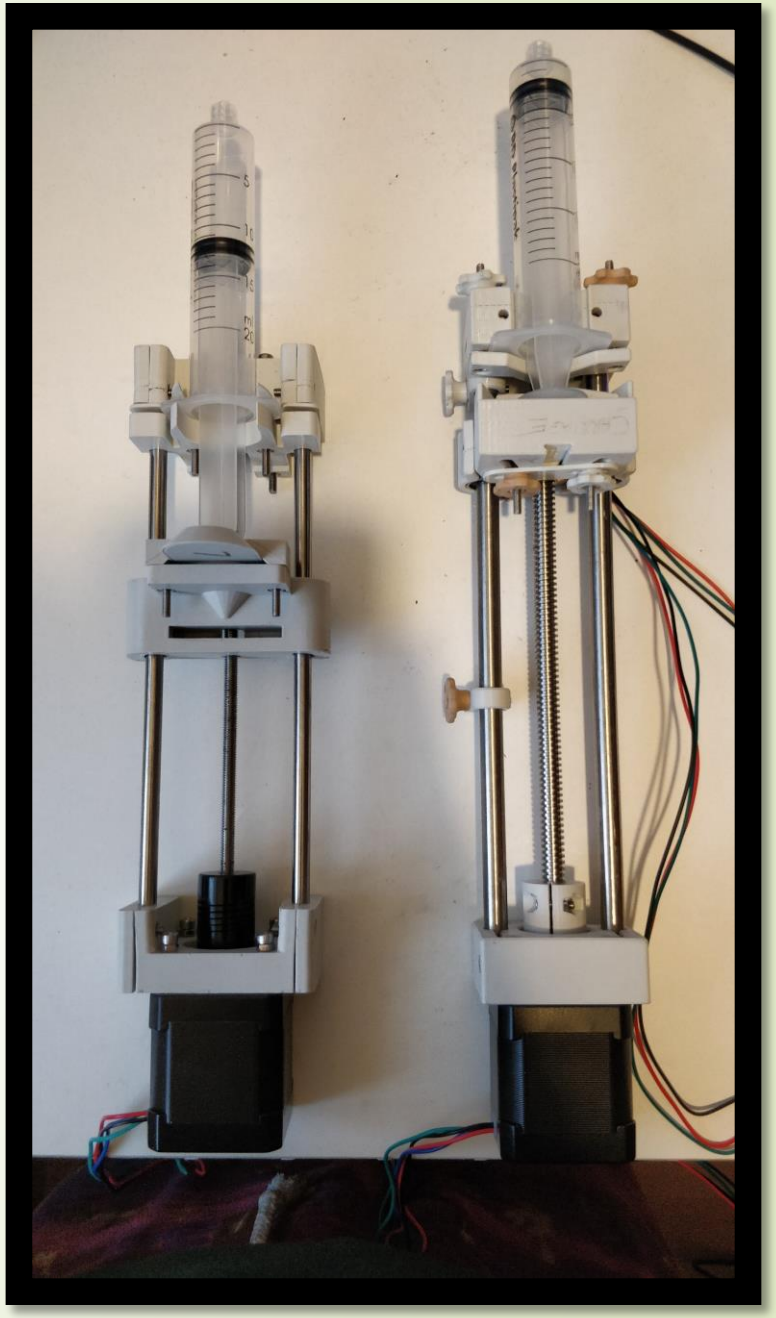
- Hardware Calibration
  - Printing Material – PLA
  - Bed Levelling
- Use of Software
  - Slicer – Ultimaker Cura
  - Print Settings
    - Print Speed
    - Retraction
  - 3D Modelling – Fusion 360





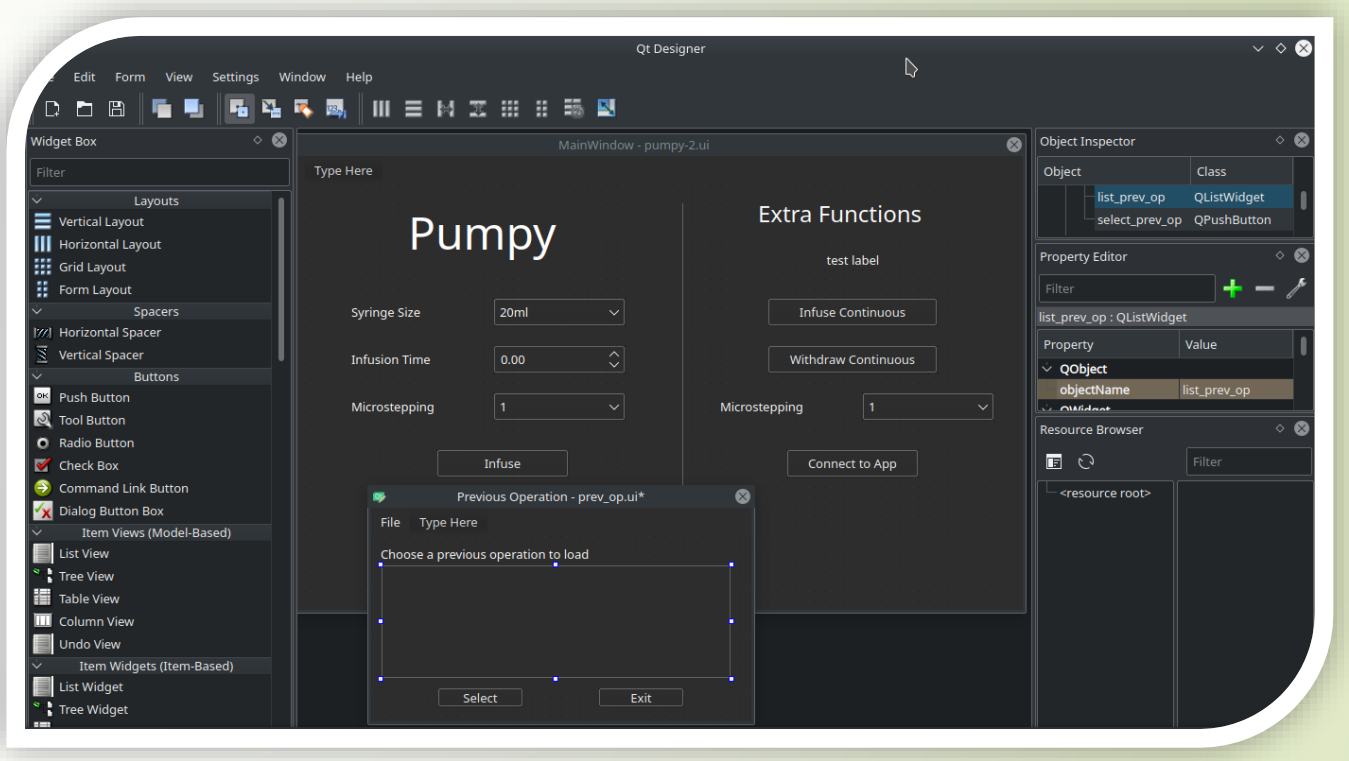
Development, Design and Manufacturing
Designing and Building a Syringe Pump

- Choosing the Equipment
  - Raspberry Pi
  - NEMA 17 Motor and A4988 Driver
  - Steel and Threaded Rods
- Ordering the Hardware and Electronics
  - Syringe Pump v1 - £112.03
  - Syringe Pump v2 - £146.22
- Creating the Syringe Pumps
  - V1: OSSPL Proof of Concept with modifications
  - V2: Overhauled design with new features



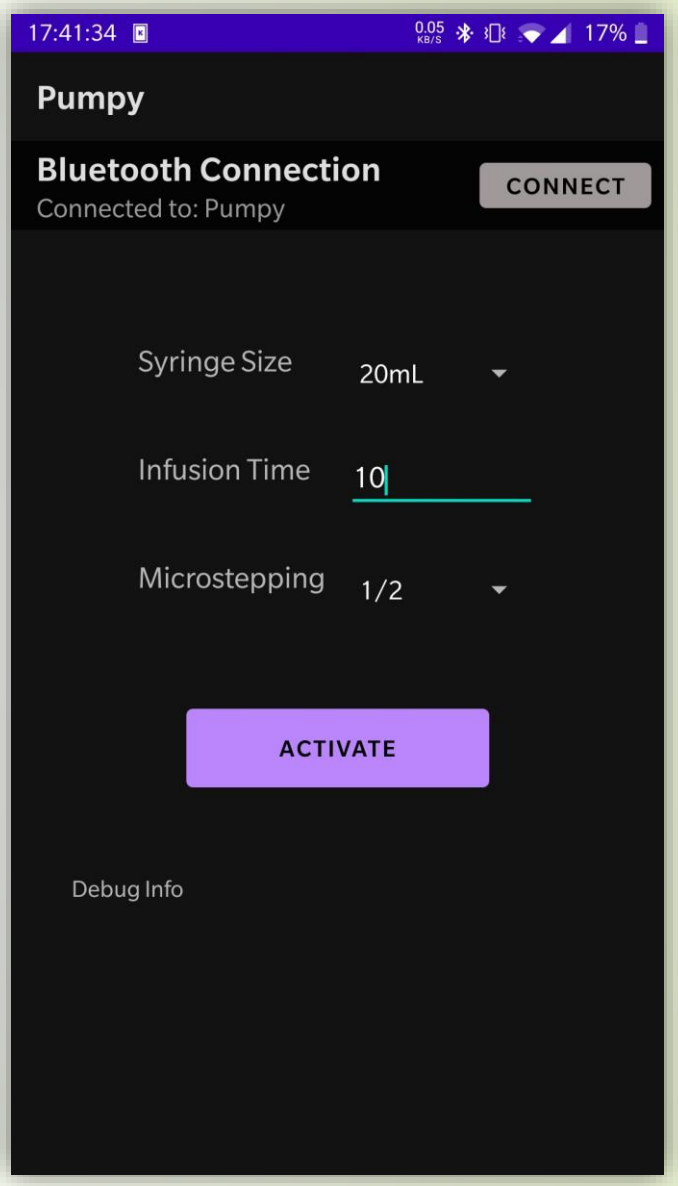
Development, Design and Manufacturing Creating a GUI

- Choosing a GUI library – PyQt
  - Many were tested – Tkinter and Kivy
- Design an easy-to-use UI
  - Performs basic operations
    - Infusion, Withdrawal, Load Operations
  - Clean and uncluttered view
- Extensible code base
  - Easy to add new menus with Qt Designer
  - Libraries for remote operation

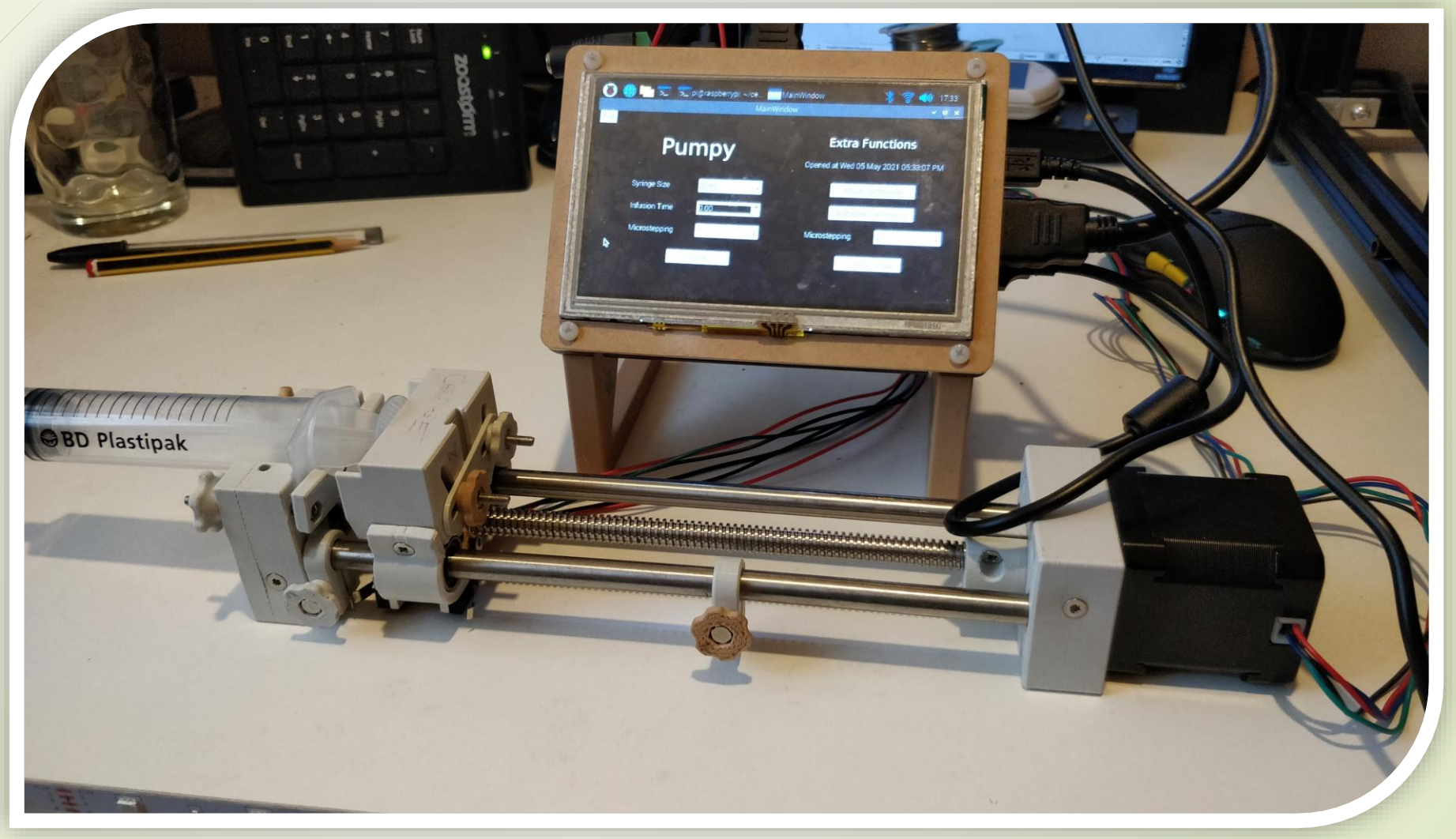


Development, Design and Manufacturing
Building an Android Application

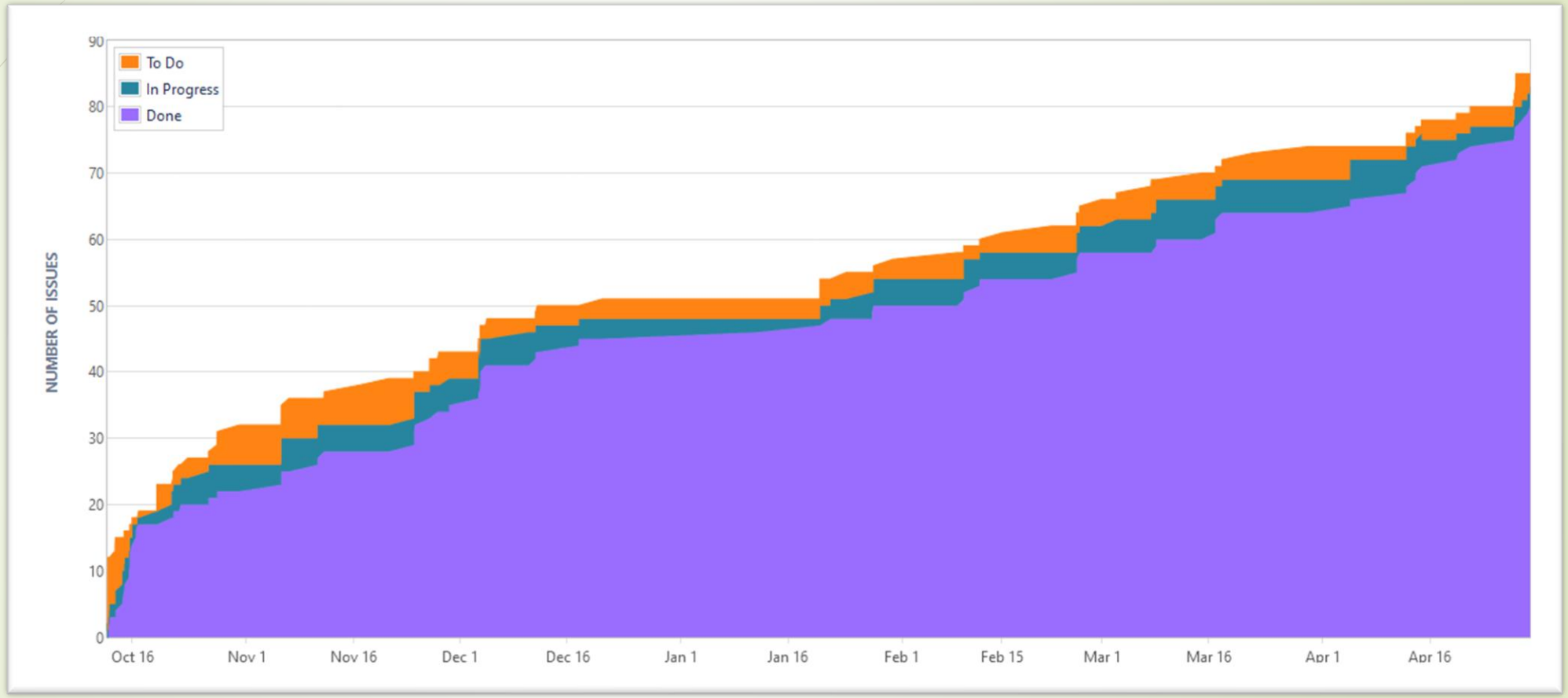
- Choice of Mobile OS – Android
  - Most used OS for mobile devices - >70% market share
- Method of communication – Bluetooth
  - Built into Raspberry Pi
  - Well documented libraries for implementation
- Building the Application
  - Android Studio and Java
  - Same theme as Pump GUI
  - Extend Python code to accept Bluetooth



Demonstration



Project Planning



Project Planning

- Began with a Gantt Chart
  - Overestimated workload
- Weekly Meetings
  - Break tunnel vision
  - Reassess current aims
- Use of Gitlab
  - Easy to document
  - Simple sharing of code base

	DESIGN AND MANUFACTURE OF A SYRINGE PUMP – GANTT CHART									
WEEK NO	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	12/10/20	19/10/20	26/10/20	02/11/20	09/11/20	16/11/20	23/11/20	30/11/20	07/12/20	14/12/20
OBJECTIVES										
Challenge Week – Tasks on JIRA										
Write simple pump program in Python										
Build Syringe Pump v1										
Testing Flow Rate										
Testing Microstepping effect on accuracy										
Modify STL files for Lynch additions										
Incorporate limit switches on either end										
Work on kivy touchscreen UI										
Write backend code to interact with UI										
Modify STL files for dual pump system										
Print and build Syringe Pump V2										
Design simple clamp to attach 2 pumps together										
Update UI and backend code to support 2 pumps										
Work on Bluetooth serial protocol for Android										
Build basic UI for Syringe Pump Android App										
Prepare for Oral Presentation										

Conclusions and Future Work

- Built an Open Source Syringe Pump for under £150
  - Has the potential for medical use
  - More work would need to be done
- Open Source Medical Equipment projects exist
  - Glia – Open Source Stethoscope
  - JOGL – Open Source Low Cost Syringe Pump adapted to Hospital Uses
    - Can continue development of the project through these
- Future work to do for my own Syringe Pump
  - New infusion calculation using flow rate rather than distance moved
  - Optimize GUI multithreading and allow addition of custom syringes