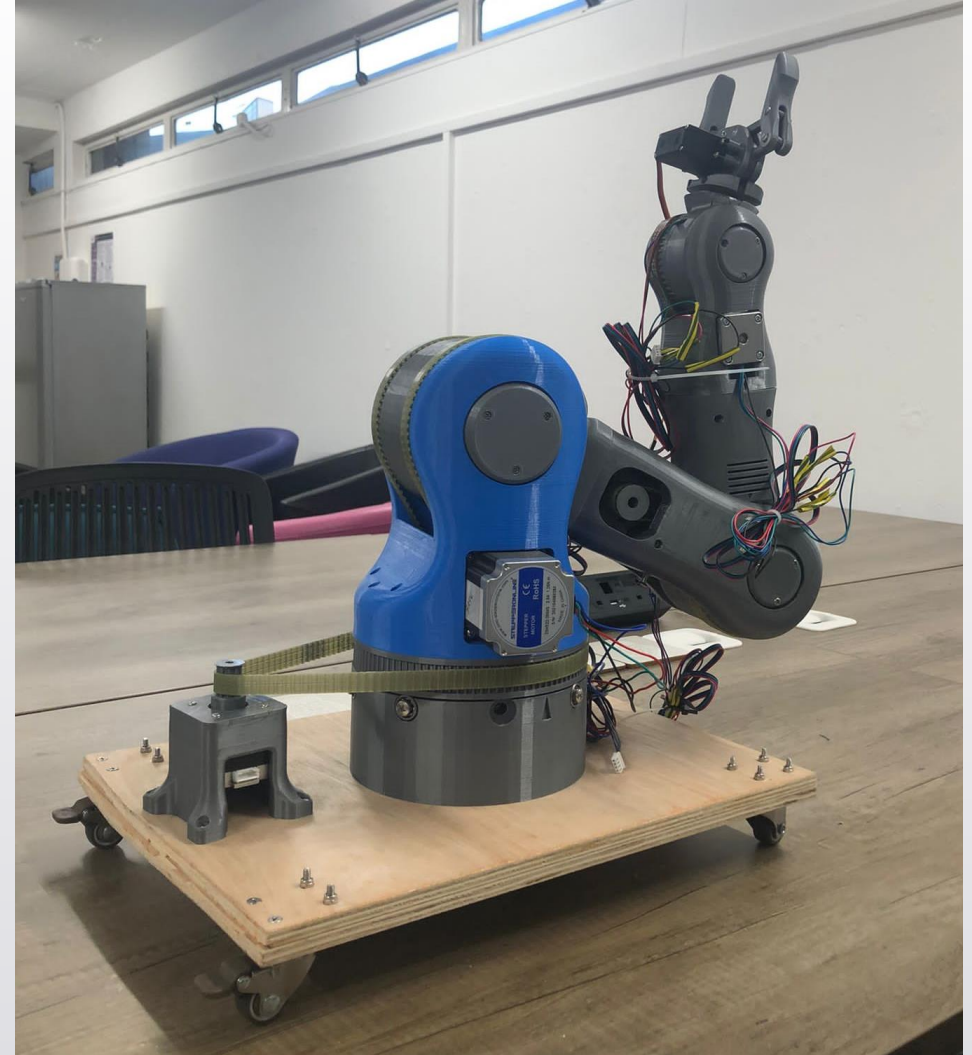




Robotic Arm Project

2022-2023

Jacques Cloete





Project Motivation

- **Autonomous service robots** are a growing industry
- Plenty of applications:
 - **Domestic care (e.g. hospitals, retirement homes)**
 - **Fruit packing**
 - **Surveying**
 - **Maintenance in remote locations (e.g. oil rigs)**
 - etc.



Project Motivation

- Unfortunately, most robot models are incredibly **expensive** (£10,000's), thus not being economically viable for home use
- **We wanted to change this!**
- We set out to build a robot arm at **low cost** (<£1000) that can robustly and reliably perform all sorts of useful tasks

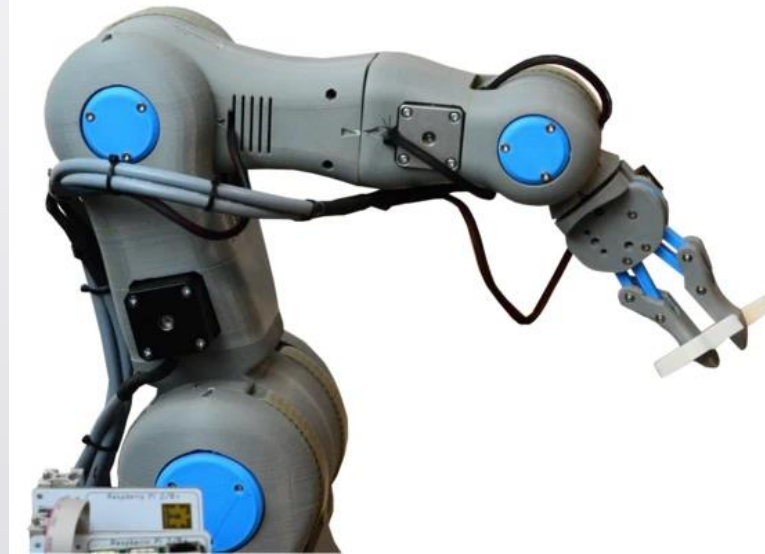
Our Long-Term Goal...

- Program the arm to play **chess** for or against a human
- Will use a camera to **observe** the board and determine chess piece location
- Can listen and respond to **voice commands**
- Most importantly, can **pick** and **place** chess pieces accurately and reliably



The Chosen Arm

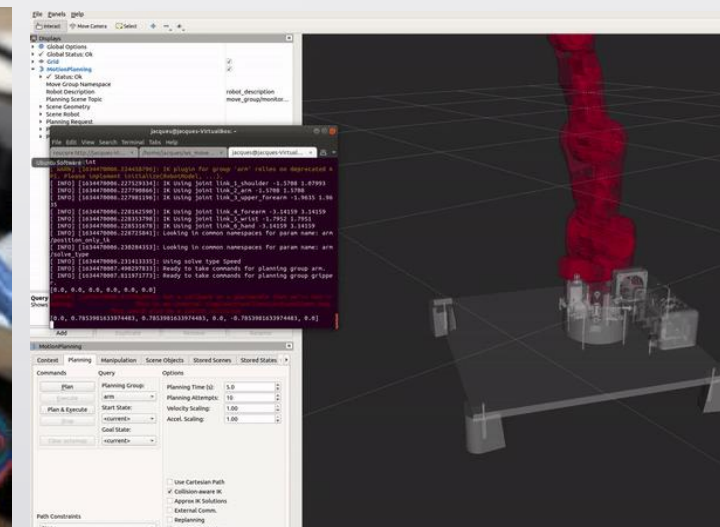
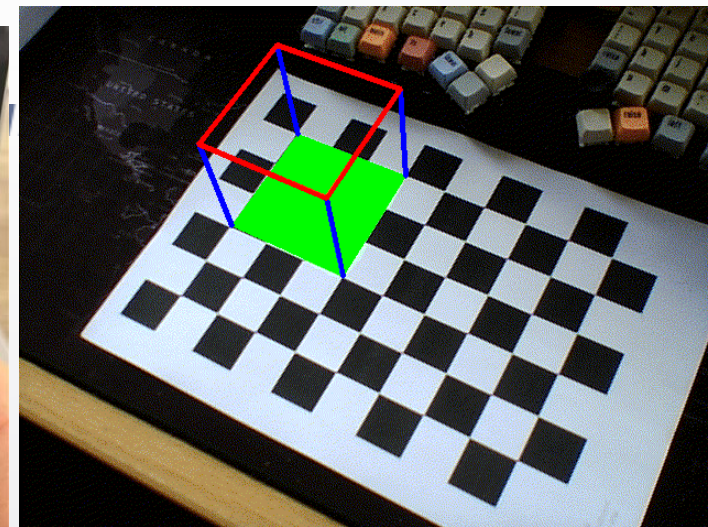
RBX1 by Roboteurs
(note: 6 degrees of freedom)

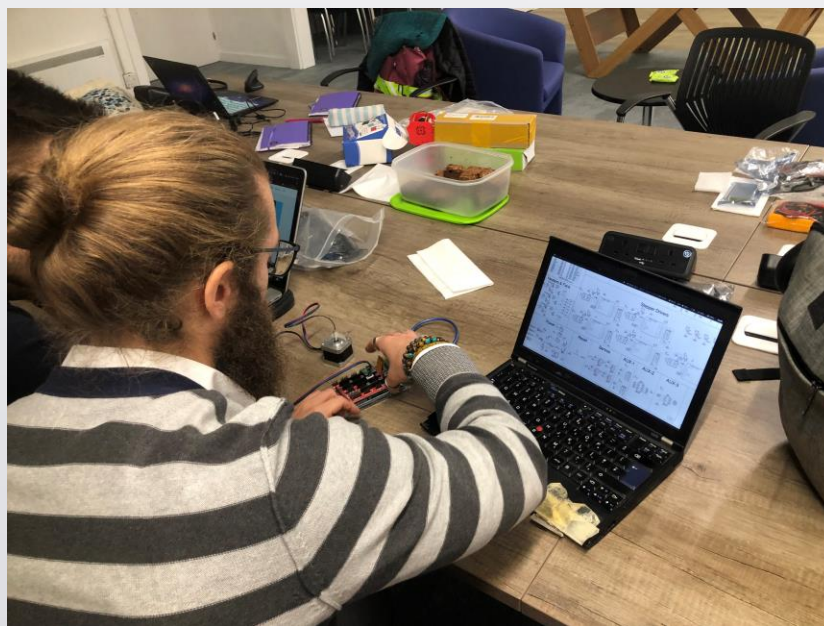


- In future we may print and build our own designs

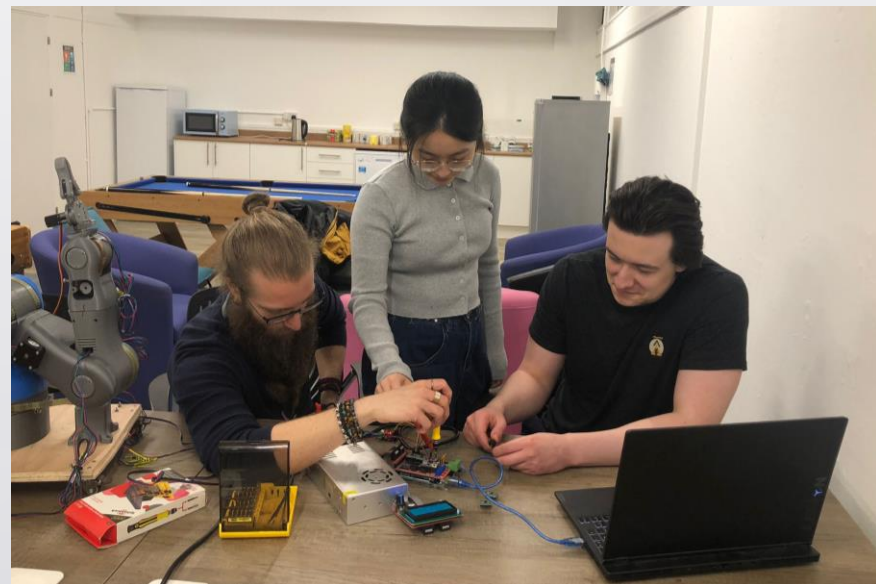
Milestones Completed

- ✓ Built MVP arm
- ✓ Bilingual command recognition
- ✓ Custom chess piece design
- ✓ Fast chess piece detection
- ✓ Point-to-point motion planning
- ✓ Chess board detection
- ✓ Pipeline from simulation to motor control
- ✓ Arm printed and assembled!





MT 2021



HT 2022



Milestones To Reach

- Develop software for task-planning and control
- Electronics testing & debugging
- Determining chess piece coordinates from CV data
- Integration of chess AI
- Merging all the software
- Lots of options following these!

Software: The Biggest Challenge

- At this point, **software** is the main project focus
 - We've built the arm, now we need it to do stuff!
- We will use **ROS**, the Robot Operating System, as the framework for programming the arm
- We will make use of key software packages such as **Movel***t*, a motion-planning framework
- We will be coding in **Python** (or C++, if you want!)

 **ROS**

 ***Movel*t**



Project Plan – MT 2022

- A series of **software lectures** teaching how to **program robots with ROS**, held **online on Teams** from **8-9pm every Wednesday** (Weeks 3-8):
 1. Introduction to ROS & Linux
 2. Getting Started with ROS
 3. Creating ROS Nodes in Python
 4. ROS Services
 5. ROS Actions
 6. State Machines in ROS
- **Workshop sessions** (and Lecture Q&A) **10am-12:30pm** every Sunday



Project Plan – HT 2022

- An introductory lecture for **Movel**t at start of term
- Coding challenge: **Box Stacking**
 - You will create your own software and algorithms to get the robot arm to stack a set of 3D-printed boxes
 - More on this next term...



Plenty of Room for Project Growth!

- Different ways to accomplish the same outcome; new ideas and approaches more than welcome!
- We can add more functionality as project develops (e.g. arm sets up chess board before game starts)
- Future projects: Fruit packing, table tennis, etc.

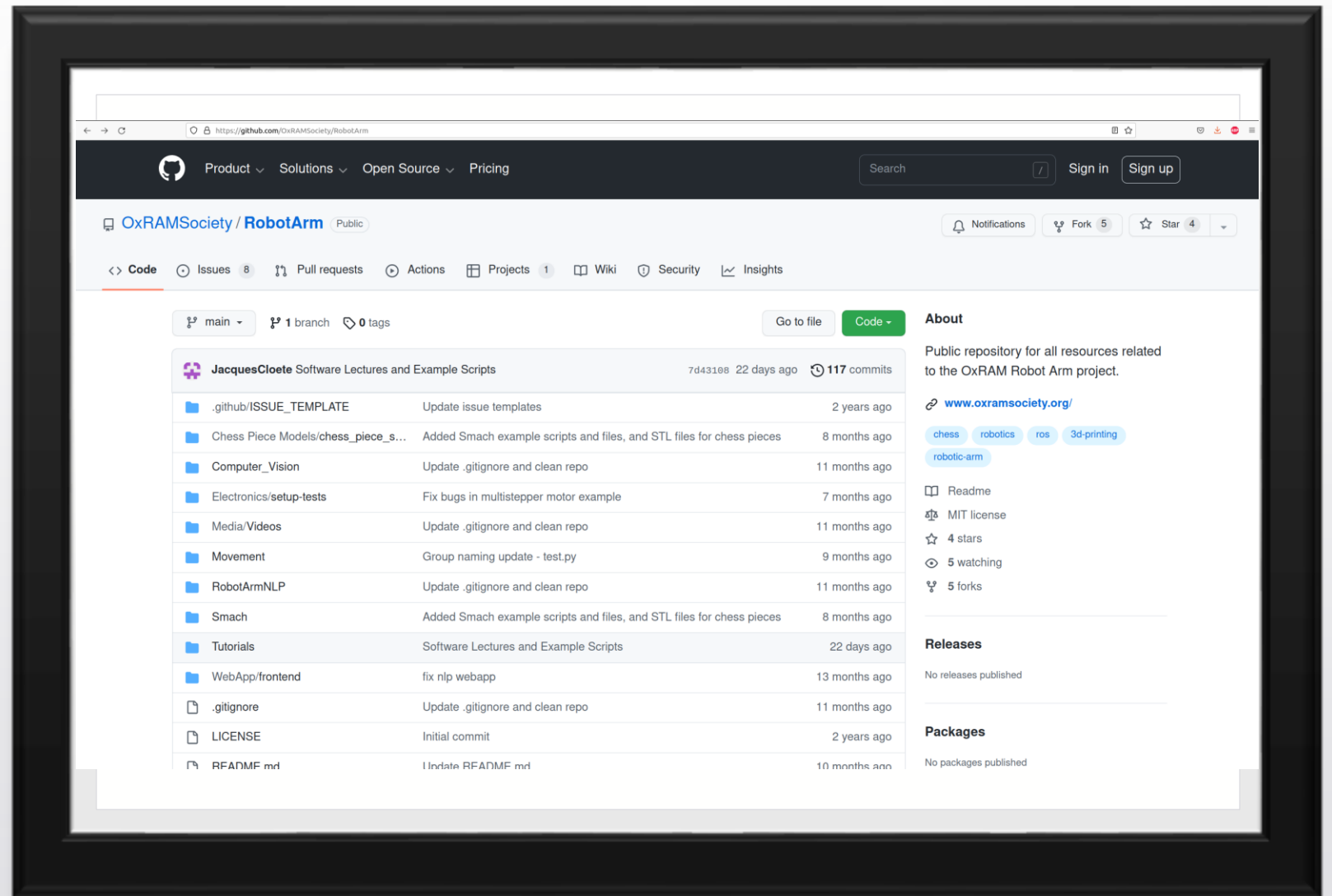


What we can offer you

- The arm, as a test bed for your code
- Experience with 3D printing, Linux/ROS, and Raspberry Pi/Arduino
- An open forum to steer the direction of the project and meet people who have similar interests

Our GitHub Repo

- Public repository for all things to do with the project
- Documentation, wiki, example code, and much more!
- **Lecture slides here** if you can't make one!





Any questions?

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Thank You!



- Contact emails:

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- GitHub Repository:

<https://github.com/OxRAMSociety/OxRAM-Robot-Arm>