Paparazzo
Automated Imaging System

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1 Introduction

Paparazzo is a modular, automated imaging system developed for photographing well plates and similar scientific samples. It combines a Raspberry Pi with camera modules, an Arduino-based motor controller, and a custom software suite to automate high-throughput image acquisition.

2 System Overview

The system consists of the following main components:

- Raspberry Pi 4 with a PiCamera v2.1 module.
- Touch display
- Arduino microcontroller connected via USB, controlling a NEMA 17 stepper motor via a TB6600 driver.
- Motorized rail system to move the camera above the sample plate.
- Python software for capturing, naming, and storing images based on well position.

3 Installation

3.1 Hardware Setup

1. Connect the display and the camera to the Raspberry Pi.
2. Connect the stepper motors to the TB6600 drivers and then to the Arduino.
3. Power the motor driver with a 12V supply.
4. Ensure the Arduino is connected to the Raspberry Pi via USB.

3.2 Software Setup

1. Flash the Arduino with the provided firmware using the Arduino IDE.
2. Install the required Python packages on the Raspberry Pi:

```
git clone https://github.com/florianfeigl/paparazzo.git
cd paparazzo
chmod +x install.sh
./install.sh
```

3. Run the paparazzo program: `paparazzo`

4 Usage

The *GUI* is constructed in two lines. *Line 1* consists of three horizontally arranged frames. *Frame 1* contains the configuration panel, where the run properties are set. *Frame 2* holds options to load the firmware and enter a manual mode (not implemented yet). *Frame 3* stores the cancel and closing window option. *Line 2* offers a detailed real-time log. See Table 1 for illustration.

Frame 1: Configure	**Frame 2:** Execute	**Frame 3:** Terminate
Logging: Detailed real-time process information updates.		

Table 1: GUI structure: three frames in Line 1, single log area in Line 2

4.1 Starting the Imaging Process

1. Launch the control script on the Raspberry Pi.
2. Enter run settings, cycles and sleep time between cycles.
3. Load the configurated firmware onto the Arduino using the `Programm laden` button.
4. Hit the `Starten` button to start the run.
5. The motor will home and then move to each well position in sequence.
6. At each position, an image will be captured with timestamp and named according to the row (A–D) and column (1–6): `{timestamp}_{row_value}{col_value}.jpg`.

4.2 File Output

Captured images are saved in the designated output folder in the following manner: `/home/pi/paparazzo/images/run_{timestamp}/cycle_{CYCLE_COUNT:02d}`

5 Maintenance and Troubleshooting

- Ensure the camera lenses are clean before each session.
- Do not manually move elements attached to the motors when they are powered.
- The camera should be aligned as precise as possible beneath the first well, serving as home position.
- If the motor stalls, check power and wiring to the TB6600 and motor. If this occurs, the camera needs to be re-aligned at home position manually.
- If cables loosened, check Figure 1 to ensure correct wiring.

- Serial communication issues can usually be resolved by restarting the script or the Raspberry Pi.

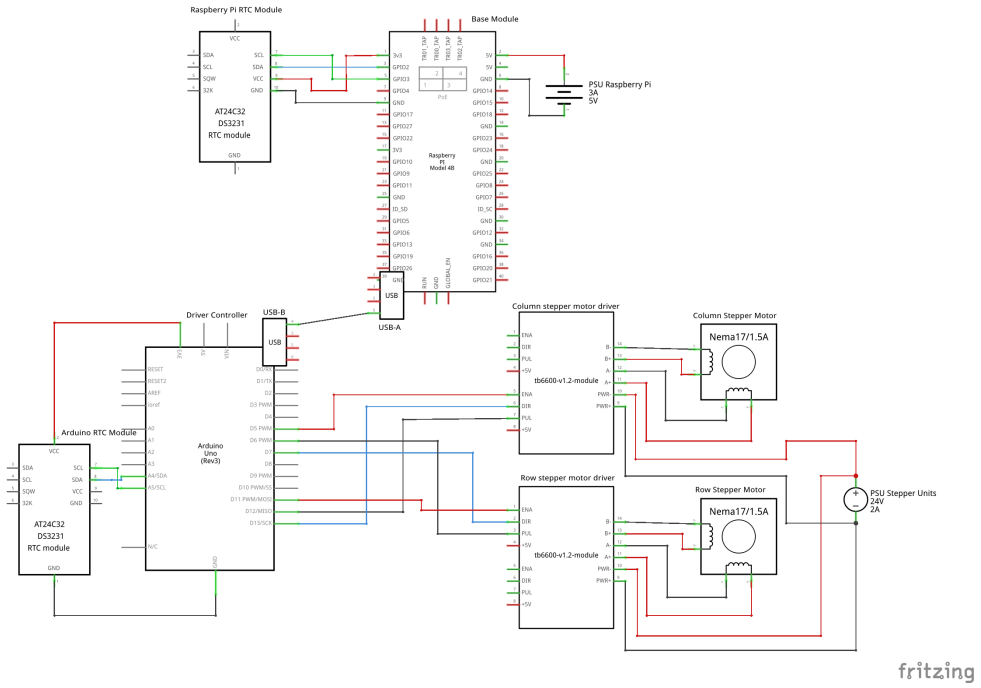

Figure 1: Engineering drawing of the Paparazzo system.

6 Customization

You can adjust:

- Movement parameters in the Arduino sketch (e.g., step delay, microstepping).
- Naming conventions or output format in the Python script.
- Plate layout by changing the grid configuration (currently 4x6 wells).

Note: If you do change anything in the firmware or the python packages, the program needs to be reinstalled (`pip install .`). If you are going to make lots of micro-adjustments, you might consider installing the program in editable install mode, so changes are applied without a reinstall (`pip install -e .`).

7 Contact

For questions or contributions, contact: `florian.feigl@stud.plus.ac.at`