**Smart Excavator Based on ADI Technology**

**Individual Report – 11/7/2016**

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**Preface**

This report covers what was completed in the second week of the project. Not much was done overall, but a somewhat large step was made. All details will be covered in the section below.

**Tasks Completed**

The Raspberry Pi 3 was successfully set up with the latest version of Rasbian (a version of Debian Linux for the Pi) and SSH (Secure Shell, remote command line access), as well as VNC (Virtual Network Computing, similar to remote desktop) were all set up for use back in my student room on campus. This involved installing some software, namely TightVNC (a VNC compatible server and client) and Nmap (an IP address analyser, which I use for scanning the IP addresses on a subnet of a WiFi network). This was all necessary, as my room does not have a TV or monitor, making it much easier to use the Pi over the WiFi. I also installed python-dev and some other necessary libraries/programs that may come in useful for the remainder of my time here.

The research into HATs was not required. The team purchased two Motor HATs, with support for either 2 stepper motors, 4 DC motors or 4 servo motors. However, there is no brand name on it, only the name “Stepper Motor HAT v0.1”. I decided to find out if there was any English documentation (since I suppose that there may have been Chinese documentation via the Taobao page) and if there was any libraries available for the HAT. Libraries are necessary, as the Raspberry Pi needs to communicate with the HAT via the GPIO, but how the GPIO then communicates with the motors is difficult to discern. An existing library would handle all communications and would abstract everything to a level where only simple commands are needed to use the motors connected to the HAT. (**Insert image of board here)**

Luckily after a day or two of searching (using my limited Internet access), I found an aliexpress page selling the exact same HAT board. It had links to the documentation and the library. Upon closer inspection, the documentation covered using DC and stepper motors, but not servo motors. However, the library .tar archive contained not just the Python libraries, but also example test code for each type of motor. **(Insert link to sourceforge here**) With the test code as a base, I can refer to it when writing my own code for servo motors.

Regarding the base vehicle, I managed to find one on Taobao (with the aid of Google Translate) that is identical to the 6 wheel drive one I found elsewhere. (**Insert Image here)** There is also a 4 wheel drive version of the vehicle, so I shared both links with the team and we have still yet to make a decision on which we want, or whether to go with something cheaper. The bases I found are very good for all terrain travel and certainly will be sturdy enough for the equipment it will have to carry. The only issue will be looking into the motor ratings (operating voltages and current) and seeing if they are compatible with the motor HATs we currently have. The HATs we have can accommodate 5V-12V motors at no more than 2A. If outside that range, the board or the Pi or the motors themselves will suffer damage.

I also did not realise that the team already had a robotic arm. It is a simple cheap hobbyist arm, constructed from sheet metal (most likely aluminium, since it is reasonably light) and it has 6 servo motors (2 small and 4 large) for a total of 6 degrees of freedom. It currently has an Arduino Uno and a motor/sensor SHIELD attached, along with what seems like a 3 cell LiPo battery. It currently has no claw or scoop attached, so we will have to find one to attach to the end of the arm. This robotic arm needs to be checked for compatibility with the Pi motor HAT we have. (**Insert image here)**

Regarding GPIO, although we may still use either the built in Python library or the wiringpi.com C++ library, the Python library for the motor HAT deals with GPIO pin assignments and driving for us. Therefore nothing needed to be done in this area, although when we attach sensors, I may look into GPIO libraries again, or find a suitable sensor HAT that we can attach many different sensors to.

**Plan**

Firstly, the motor HAT must be tested with the existing servo motors on the robotic arm. Once one is tested and the code understood, I will then be able to write more Python code that can then run 4 motors at a time. In order to run all 6 servo motors, I will need to borrow Weng Zhe’s motor HAT, stack it on top of mine and then individually address both of them in order to control all 6 servo motors. Since servo motors run using PWM signals, I will need to identify the right parameters in order to move the arm to the required positions for grabbing objects off the floor and then turning around and dropping them behind itself. Of course, the positioning of each servo will depend on the relative locations of the bucket/skip and itself to the vehicle and ground. Therefore, this can only be done once the vehicle itself arrives and is assembled.

The vehicle must be purchased ASAP, so I will quickly look into the dimensions of the 6WD and 4WD vehicle bases I found on Taobao and help the team decide on which to get. Hopefully we can get this done early in the week and Huang Lu can buy the appropriate vehicle off Taobao for arrival sometime during the week. Once it arrives, assembly will be done and then we can mount the arm and find some kind of container to go behind the arm for objects to be dropped into. This should be easy to do once we have the vehicle in hand.

Once we know which vehicle we are getting, then I will have a look into the motor ratings. There is a high chance that they will run at a much higher Amp level than what the Pi motor HAT can provide (<= 2A). Therefore, I will find out if there are any alternatives, such as motor driver boards or other HATs that can be attached to the Pi, and then find out how to use them. I know that motor drivers can easily be driven by and Arduino, the issue now is the way in which a motor driver interfaces with a Pi and if there are any libraries that will make programming it easier.

**Conclusion**

Last week (4th to 10th July) was mainly spent getting the Raspberry Pi 3 set up and ready to start interfacing with some motors. Hopefully by the end of this week (by the 17th/18th), I will get servo motors working with the Pi via the motor HAT; we will have the vehicle assembled with Pi, HATs and arm mounted; and maybe even have the vehicle running and controlled by the Pi. If things go well, we may have the main hardware (except sensors) set up and working within one or two weeks, which is keeping in line with our first deadline.