**Smart Excavator Based on ADI Technology**

**Individual Report – 11/8/2016**

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**Preface**

This report covers what was completed in the third to sixth weeks of the project. Not much occurred in each week, so this report aims to compile all progress made in those 3-4 weeks.

**Tasks Completed**

The vehicle was bought and assembled. It took almost 2 weeks to arrive after we decided on which type to get. The type we ended up buying was the Dagu 4WD Wild Thumper base, which was one of the few I suggested. We went with the 4WD over the 6WD, as we did not require a massive vehicle. The 4 wheels and top mounting area were enough for the project.

A week later, Weng Zhe went ahead and mounted 4 IR sensors to the underside of the vehicle. These connect to another board, which I assume communicates with the sensors and sends data to the Pi. In fact, it is connected with several wires to the GPIO pins of one of the motor HATs we already have. Weng Zhe also wired up the wheel motor channels (one for left and one for right) directly to the HAT. Although not recommended, since the board can realistically only support 2A of max current, considering the vehicle will be moving at slow speeds, the HAT by itself will suffice. I only hope that we do not accidentally overload the board, as the motors have a stall current of 5A or so. (**Insert Images here**) Weng Zhe tested this and managed to get the vehicle to run and follow a black line taped to the floor. It can drive straight and follow curves, but I can imagine that in order to follow tight corners, the motors have to be driven differentially (like a tank).

I was given a claw to test out servo motor Python code. Since the HAT had libraries written for it, it was a simple matter of figuring out how to drive the servos. The maximum and minimum positions were easy enough to figure out, but anything in between is very difficult. Since the functions take a pulse width between 0 and 4096 **DOUBLE CHECK THIS**, it is not easy to figure out which pulse value parameter leads to the desired servo position.

Later on, I was given the entire robot arm assembly and I plan on programming some sort of function that makes it easier to set the servos to desired positions. Something like a degree (from 0 to 180 degrees) to pulse value converter would be great. Perhaps code for this already exists and that is what I am currently researching.

Lastly, I designed and 3D printed (on a Flashforge Finder in black PLA) mounts in various sizes for the robot arm. The arm itself has many mounting options, but none would fit the layout of the vehicle’s mounting surface. Therefore, I designed a simple mount which the robot arm attaches to, and then is attached to the mounting surface. **Insert CAD images here**. I started off by printing a 58x58x7mm mounting plate with the spacing between holes at 50mm. This worked out perfectly, however the 50mm spacing caused the plate to not be perfectly centred on the vehicle. I then decided to try out a 40mm and 60mm spacing. I will test both in the next couple of days to see which of these two mounting plates best supports the weight of the robot arm.

**Plan**

As mentioned before, the 3D printed mounting plates must be tested. This is a quick and easy step. Afterwards, I must focus on getting the robot arm ready for use. This will involve simplifying the use of the servo motors. I will most likely define some predefined positions for the arm, such as the default state for when the vehicle is moving and a position over the skip.

Speaking of the skip, the “bucket” or skip that will eventually be mounted behind the robot arm must be purchased or made. The size will have a big effect on the arm’s position and the vehicle’s weight distribution. If we cannot find a suitable product online, I may resort to designing and 3D printing an easily mountable box shaped bucket.

We still have not prepared a method of grabbing or scooping up objects. We need something that can mount to our current arm and can be controlled by the Pi. It will most likely use a servo for opening and closing the claw/scoop. Again, if we cannot find something online, I will try my best to design a custom manipulator for grabbing objects. This will be tough and I may not have enough time to complete it, but hopefully we can find a solution before I leave.

There is not much time left, so I will aim to get all of this done well before I finish up here at Tsinghua. After the arm and bucket are done, then the team just needs to get object detection and obstacle avoidance working. Otherwise, all the main hardware will be complete and partially ready.

**Conclusion**

Given the limited time left, there is little I will be able to do before the IROP finishes. I will strive to do what I can in next week.