School of Engineering Science
Simon Fraser University
8888 University Drive
Burnaby, BC, V5A 1S6

Progress Report

Control Group

The current progress will be reported based on different functional units. Then the progress of the integration of these functional units will be presented. The following table summarizes the progress of each functional unit.

Unit	Progress
Wheel motor control	Done
Snow out direction and camera motion control	Done
Human control interface	Done
Video codec	Done
Wireless communication	40%
Power switch	0%

Wheel motor control unit

Wheel motors will be controlled by PWM (pulse width modulation). For our controlling part, it is agreed that we will generate PWM while H-bridge circuit creation will be left for mechanical group. This part is done, in other words, PWM can be generated by our ARM controller.

Snow out direction control and camera motion control

Snow out direction and camera motion will be controlled by step motors. Control group needs to send out sequences of command to drive the step motors. This part is done.

Human control interface

Users will use buttons and joystick to control the robot. USB joystick bread board with joystick and buttons equipped is used to accept user's command. Control group's task is to enable ARM development board to accept commands from USB joystick bread board. This part is done.

Video codec

Two cameras will keep monitoring the surrounding condition of the robot. Thus, control group needs to make the captured real-time image displayed on the screen. This part is done.

Wireless communication

WIFI protocol will be used for wireless communication. The hardware we chose is the USB WIFI adaptor. By now, the driver has been successfully installed. The next step is to understand Linux Wireless API and try to program with this API. Then, we could establish the wireless communication between two ARM develop boards.

Power switch

There are two power switches. One is to control on/off state of the remote controller. The other switch is to control on/off state of the robot. This part is not started.

Integration

Human control interface & wheel motor control unit

This integration aims to trigger the PWM by USB joystick controller. After some buttons are pressed, it is expected that some specific pins in ARM board will output PWM. This part is done.

Hardware Group

The table below shows the progress of the hardware group. The progress of each unit will be discussed in this section.

Unit	Progress
Snow thrower + power switch	Done
Power distribution unit	80%
Snow out direction unit	80%
Camera unit	90%
Driving unit	60%
Entire body building	30%
Safety mechanism	10%
Extension cord retractor	0%
Salt spraying unit	0% (might be cancelled)

Snow thrower + power switch

The snow thrower is purchased from Canadian tire. The power switch circuit is already designed and implemented inside the switch circuit of the snow thrower. It is also tested by using microcontroller to turn on/off the snow thrower.

Power distribution unit

The power distribution unit is responsible to supply different power ratings to most of the components on board. The components include the driving unit, stepper motors, and control circuits. We chose a recycled ATX computer power supply for the job. It is tested against different loads. It is able to supply our robot driving DC motor up to 22A from one of a 12V yellow wire. Powering stepper motors needs to be tested, and we also need to add fuses in series with each power rail to prevent excess current damaging our circuit.

Snow-out direction unit

The snow-out direction control is accomplished by using a stepper motor rotating the vanes on the snow thrower through a knob. The H-bridge circuit used to control the stepper motor is already implemented and tested. The vanes can be rotated as stepper motor turns. However, we need to look for better adhesive to connect the head of the stepper motor to the knob.

Camera unit

The camera unit only consists of a stepper motor and associated H-bridge circuit. The model of the stepper motor is the same as the one used for the snow-out direction unit. Therefore, we use the same circuit to control the motor. An acrylic platform will need to be fabricated to hold the camera.

Driving unit

The driving unit was originally planned to be constructed by us. We implemented the H-Bridge by using power transistors with heat sink. The circuit is able to drive the DC motor with no load, and small amount of current can be drawn by the transistors. However, difficulties (such as overheat, transistor mismatching and reduction in voltage) rise when we apply loads to the motor. Therefore, we decided to purchase an off market motor driver which is able to handle stall current up to 56 A. Safety mechanism is also included in the driver. The shipment should arrive next week, and we will use that as an interface between our control signals and the power distribution unit.

Entire robot body building

We decided to use Aluminum as the frame and acrylic as the ceiling and shelves inside our robot. The CAD diagram is already drawn and sent to a local Aluminum fabricator. We will purchase and machine Acrylic boards next week when the frame is completed by the shop.

Safety mechanism

Several safety mechanisms on our robot are already planned. The most important ones include emergency stop when remote control signals are loss, emergency stop button and motion detection triggered alarm. These mechanisms will be implemented during the control and hardware integration.

Extension cord retractor

We originally planned to design our own mechanism to control the extension cord connecting our robot to the power outlet. However, there are plenty of power cord retractors available on the market. Therefore, we will purchase the one matching our power requirement and install that onto our robot if our budget permits. (An extension cord without retractor might be used on our prototype since we are already short on our budget)

Salt spraying unit

The salt spraying unit might be cancelled due to the time and budget constraints. Our priorities are the basic functions of our robot such as the driving unit, power distribution and robot body.

Budget

Below is the total amount of budget we have spent so far on the project. Overall, Helper Tech has already purchased almost every component required in the project and is currently under budget where the total spending is about the same as our initial estimated cost.

Item	Cost
Hardware	
Snow thrower	$172.23
Robot driving DC motor x2 + shipping	$576.47
Stepper motors x2 + H bridge IC x2	$76
Power switch module	$44.58
Motor Driver (dual 25A)	$128
Miscellaneous	$50
Software	
ARM development board	$200
webcam	$40
joystick	$20
Total	1307.28