Hello everyone! I’m Huang Lu, a junior from EE. Now I’m going to talk about our project: Smart Excavator Based on ADI Technology.

Firstly, I’ll give you some general information of our project. Why we want to develop such a smart excavator? For what? I think there are two points: to improve mining efficiency and to ensure safety, because traditional excavators are inefficient and unsafe, as well as lack of accurate measurement of weight. Meanwhile, unmanned, intelligent, interconnected devices have become a trend, as the concept of “industry 4.0” has been proposed. Our smart excavator is based on the structure of LEGO’s toy excavator and ADI technology, with the functions of target recognition, automatic digging and dumping, weight measurement and foreign object detection. We divided the system into five modules, and we may choose ADZS-BF707-BLIP2 or ADSP-BF54x/BF60x/BF70x for MCU. In some modules, we want to choose ADUC83x/ADUC84x/ADSP-CM40x as the module’s controller. Also, we choose EVAL-ADXRS290Z for shedding and ADA4571BRZ for angle measurement. In the future, we want to develop more excavators and trucks and realize the communication between them. Also, we want to take some realistic factors into consideration, like traffic lights, roadblocks and etc.

Now I’m going to talk something about our team. We have four students now, with two from EE(that’s me and Wan Shuo), one from Department of Microelectronics and Nanoelectronics(that’s Weng Zhe), one from Department of Mechanical Engineering(Xu Jirui). Also, we still need a partner from Department of Automation. My research direction is signal processing, like image processing or speech signal processing. As a leader, but I would like to call that organizer, I am responsible for project management, panel discussions. Also I want to deal something about visual processing and hardware implementation. Weng Zhe is taking a course now and is skilled in hardware design and programming. He is responsible for the design of hardware system and its partial implementation. Xu Jirui, a graduate student, is good at mechanical structure designing, kinetics analysis, mechanotronics and skilled in cad/cam, solidworks, proe and labview. He will be responsible for manipulator control and vehicle structure improvement. My classmate Wan Shuo’s research direction is image processing and machine learning. He is responsible for target detection and recognition and partial hardware implementation.

Then I’ll talk something about the excavator to you. We envisage that it can moving to the target area firstly by tracking line, and then by ultrasonic ranging and image processing; then it can dig and dump the soil onto the truck’s bed automatically; then it drives itself to the destination given by us. In the process, it can detect the surrounding environment and avoid any hurt to people or animals approaching it.

So we divided the system into several modules, besides the module for power supply, we have four modules for motion control, target detection and recognition, manipulator control, foreign object detection. And some of them may need to cooperate through inter-module communication.

Now let’s watch a more detail figure. This figure is drawn by Weng Zhe and it described the system architecture. The blue ones are modules’ names, gray ones are hardware devices, green ones are about software processing, and yellow ones are machine structures. As you can see, we plan to use lithium battery as regulated DC power. In the module of target recognition, we use ultrasound wave to measure the distance and cameras to get images and then we use this information to detect and identify the target area, and make a decision to tell manipulator and vehicle how to work. In foreign object detection module, we also use ultrasound wave to detect if there is a person or animal approaching. In this module, we may also use camera to get images to improve the accuracy of detection. in the module of vehicle motion control, we need to detect vehicle body's posture and use motor drive to control the speed of vehicle. In the module of manipulator control, we need to detect pressure to measure weight and use rudder to control the motion and posture of manipulator.

Our project will be divided into three stages. In the first stage, the vehicle approaches the target area by using infrared to track line. In this stage, we need to achieve three functions: motor drive, tracking line and truck bed control. And in the second stage, we add all sensors onto the excavator, including ultrasonic sensors, camera(s), magnetic angle sensors, gyro and weighing chips. And in this stage, we’ll realize several functions: ranging, motor control and obstacle avoidance. In the last stage, we will focus on the modification and control of manipulator. And then we will finish the functions: target detection and recognition, manipulator control.

But since we have just started, we may face a lot of potential problems in the future.

Such as how to distinguish the target area and foreign object accurately?

How to improve the accuracy for inter-module communication?

How to avoid the collision between manipulator the bucket?

How to measure the weight of the “soil” fetched by manipulator?

When comes to ADI parts, we want to use ADZS-BF707-BLIP2 or ADSP-BF54x/BF60x/BF70x for main control and several ADUC83x/ADUC84x/ADSP-CM40x for modules control. We also choose ADUM7234 for Isolated Half-Bridge Driver and some sensors and several Operational Amplifier.

As for the budget, our total is thirty thousand, including hardware and chips, human resource and others. In hardware and chips, we need LEGO’s toy excavator and its fittings, sensors, SCM, manipulator, cameras and etc. Also there has labor service fee for ourselves and others having helped us. And we need to print, buy books, and apply for patent.

OK. Thanks for your listening! Thank you very much!