- ➔ Project Description Overview
  - Majority is to develop software to have it navigate autonomously
  - Complete work that P11215 does not complete
  - Also adding a few features
  - Goal is to have it done by ImagineRIT
- ➔ Mechanical Engineering Aspects
  - Customer Needs
    - Described our customer needs
  - Engineering Specifications
    - Described our engineering specifications
  - Risk Assessment
    - Described our engineering specifications
  - CAD Assembly
    - Showed CAD
    - Also have actual robot
  - Sonar layout
    - Tried to improve the sonar range
    - Explained layout both before and after. (i.e. what was going on before, and what we're going to do now
    - They're physically the same sensors
    - Height changed for the sensors
      - Before it was a 3-tier system; now it's able to see better
    - CAD has been changed, but the mounts have not been built yet.
    - Concerns
      - Vibrations
        - Is there any kind of bearing or something, because it's going to shake?
        - Can make a bracket to hold center of gravity over the robot
      - Bearing is built into the servo-board, but it's a plastic one
      - Going to be scanning constantly, is the ribbon cable hanging down again with vibrations; will the cable will be able to take that kind of stress?
        - See if there are specifications about the fatigue of the ribbon cable.
      - Mechanically it might have to be "beefed" up a little bit.
        - Make it, and see how much wiggle there is; and then modify if necessary.
        - Might be okay
  - Water Deterrence System
    - Three components
      - Sprayers
        - Have red LED's built into them
        - Can show that the robot is "angry" or "upset"
        - Will also warn them.
      - Pump

        - Using a windshield washer pump
    - Reservoir
        - Going to have a separate reservoir for the system. So that it can take care of the plant separately from taking care of the plant
- Going to mount below or above
- Concern:
    - Will it be possible to fill easily
        - Will be mounted so that both can be filled easily
    - Size of tank
        - Just a car windshield reservoir

- Adjustable Plant Holder
    - Explained design
    - Concerns
        - Vibration
            - Use wingnuts or lock washers
            - If you had a series of holes, you could put a counterpin through instead.
                - Instead of having it threaded, you could just put pins in.
        - How is it holding?
            - It's a cantilever beam
                - Might not be able to hold up to vibrations and mass of plant when the robot is moving. Make sure to count in to see that it works
                    - Spacing of the 2-rod side might not be large enough.
                - How much does the plant weigh?
                - Determine maximum mass of plant and statics of the plant and if the plant holder
                - Then determine the dynamics when the robot is moving and vibrating and what that's going to do.
                - Then count in factor of safety of a child hanging off of the front of the robot

- Additional Plants
    - Described the design and idea
    - Nylon webbing
        - Better than chicken wire, because of sharp edges cutting into the electrical or injuring people.
- Test Plan
    - Described test plan

➔ Electrical and Computer Engineering Aspects

- Customer Needs
    - Described electrical customer needs;
- Engineering Specifications

        - Described engineering specifications
    - Risk Assessment
        - Described risks
        - Are there any heat generation issues that we have to worry about?
            - Voltage regulation was an issue; stepping it down was an issue
                - Solution was found, is now working okay
            - Heat issue in the box is not an issue
            - What happens if the fan should fail?
                - Not yet; Need to look into it
            - More of an issue because the WA is going to be in direct sunlight
                - The sun is going to heat up the robot, and things are going to stop working
                - Might need to get a temperature sensor to monitor the temperature of the robot itself when it's out under the sun
                    - Add three more temperature sensors to monitor the temperature (look into to see if we need to add it)
                    - Shouldn't be too difficult to implement.
                - Are the bearings sealed?
                    - The motor definitely is, not certain about the bearings
                - The wheels are getting ventilation.
    - Sonar Servos
        - Explained the sonar system and circuit
        - Hasn't actually been implemented; Should be done next week
    - Bump Sensor
        - Described bump sensor system and circuit
            - Initially were planning to have two bump sensors, decided to get rid of the sensor in the back because of cost.
                - Generates a risk
        - What's the isolator on the on board system.
            - Principally they're the on board and the circuit diagram are the same, they just look smaller
    - Moisture Sensor
        - Described moisture sensor
        - Looking at the data; range should be from 3V down to 0 V…it seems to saturate at 1.5V, why doesn't it go up all the way?
            - Rui thinks it's because that means for pure water
                - Look at the specification sheet
                    - Doesn't look linear
                - Put into pure water to test. (hopefully that's the reason)
                - Put a volt-meter right across the moisture sensor as well to see if maybe the ADC isn't working
                    - Weren't using an ADC when measuring

- Solar Panel
  - Described solar panel circuit
  - What's the voltage specification?
    - Worried that if it's putting out any voltage, it will pop the LEDs
      - Was tested using maximum current and maximum voltage
      - Hunch is that the LEDs won't hold up to the voltage of the sunlight
        - Put resistors in line with all of the LEDs
        - Put a zener where the resistor currently is (or a diode)
      - Get bigger LEDs so that they light up
    - Get book and see what's recommended for the circuitry for the solar panels and LEDs to make sure that the LEDs will not break
  - Throw away the on-board diagram; because it looks like a schematic, but it's not. Fix it so that we know it's not a schematic and it's how things are soldered.
- "Indiana Jones" Switch
  - Described "Indiana Jones" switch circuit panel.
- Emergency Stop Buttons
  - Described the emergency stop buttons
- Beagleboard/MSP430 Communication
  - Explained the beagleboard/MSP430 communication
  - Beagleboard can get data whenever it wants
    - When the flag gets set, beagleboard knows that it has to pull the data
  - Time is still TBD regarding the heartbeat; will probably be a second or two
    - Need to wait until the software is done before setting the time for the heartbeat
- Test Plan
  - Described test plan
    - Only thing that's changed since the last group is the sonars
  - How long does the sonar have to be set in one spot before it can take an image, or does it happen instantaneously?
    - Pretty much instantaneously
    - Will move in sequence with the robot so that they move not simultaneously
    - Sit down and test the sonar/servos to see what data we're getting at the moment.
      - Analog side was working well; Which was the plan all along
      - Make sure all 4 sonars are functioning properly and the range that you can get accurately
        - Before, as long as it was larger than 1ft, and less than 20ft it was okay.
        - Determine what happens if somebody or something is near it
        - Test all four again.
    - Why does only one turn on at a time?
      - Worried about mix-of communication when multiple are on
- Other Comments/Questions
  - Rui: Look at the sonar, and gain familiarity with it

        - Find out how they work
        - Were having problems with the analog, but now everything works. (Ken looked at it) and will own it.
    - GPS owned by SEs
    - Electronic Compass is owned by Ken as well
    - Rui or Ken need to own Battery; might be the responsibilities of SEs
    - LCD might be getting used? Responsibility of the SEs if it is. Would be nice because it would allow us to know if the robot needs to be charged at the end of the day without hooking it up to a voltmeter each time.

➔ Software Engineering Aspects

- Customer Needs
    - Described customer needs (QNX, Navigation, Personality specifically)
    - QNX will probably not work out; going to use Angstrom
        - Same functionality, but will just be a little bit harder to transfer the programs.
    - What happens if device is traveling on terrain, (concave down and concave up)? What will happen with the robot due to that little bit of a dip?
        - Bump sensors are height adjustable
            - Their specific height was picked because you don't want the robot to run over people's feet.
        - Also, robot is going to be in a static terrain that will be picked specifically so that this situation does not occur.
- Engineering Specifications
    - Described engineering specifications (personalities, not bumping into people, not falling off ledges specifically)
- Risk Assessment
    - Described risk assessment
    - Two of them are based on QNX. It was decided today that QNX isn't going to be used, so those are no longer risks
    - I2C is working, so that is no longer a risk
- Design
    - Described design and a few small changed
    - Labeled what's going to be serial communication versus registers.
        - Made it more detailed
- Class Descriptions
    - Were not really described since they can be read.
- Pseudo-code Examples
    - Described pseudo code
    - Movement library
        - Described what the movement library is and does
        - What if you wanted it to go slower or faster?

        - If you wanted to go slower, there are three methods that would allow the speed to be changed and adjusted accordingly.
    - There's direction, speed, and encoders. Do the encoders fit in?
        - Not into the movement library, they go into "calculate move"
        - When pseudocode was made, it was assumed that when you send the wheels a value, they will both be using the same one
    - What does the course correction?
        - Mostly sonar and IR, and the bump sensor
    - Do you know what the delay is for the right wheel and left wheel and how long it will take to actually make the turn?
        - Has not been thought about yet.
    - Maybe possible to set it together for both wheels, instead of separating them to hopefully move both wheels together
        - Code was based off of the protocol
- Apathetic Wander
    - Described how apathetic wander works
    - Where is decision making made?
        - At the end of the loop. There's going to be a randomness code at the end of it.
        - It will obviously stop and turn if it runs into the "GPS corral"
    - Do a use case of the robot just wandering
    - The sequence events are interesting
        - Imagine you were in a room and had to figure out where to go; then put a blindfold on; you'll become very aware of your senses and where you have to go.
            - This will hopefully help you get the wandering and movement of the robot better.
            - Movement of the robot has to be very methodical
    - How much of personalities do you actually need to start programming?
        - Not much. We can start programming now; getting it detailed and broken down will be done later.
    - For schedule during week 10;
        - Parse out who's doing what, when
        - Also determine the "methodical" movement that Dr. Kempski mentioned above. (Maybe, move a foot. Stop. Look around. Move another foot, repeat. Or something like that)
        - If the robot can walk forward one foot on its own, we're all going out to drink.
- Important Board Specifications
    - Were not discussed
- Data Persistence
    - Discussed data persistence
    - It's a good addition.

        - Play the depth by ear
        - What about uploading the data to the web?
            - The most important factor right now is to get the data. After that we can focus on uploading it to the web
    - Polling (Hardware/Software Interaction)
        - Discussed polling
        - Want to move as much decision making as we can to leave the beagleboard.
        - At the moment just saying what we want, when we get to the point will make it more detailed
        - There's a watchdog heartbeat and a hardware/software interaction heartbeat.
    - Other Comments/Questions
        - Ken, when you pick up the MSP430s, what are you expecting to see if you want the robot to move straight (move both motors ahead at ½ speed)
            - Shouldn't be too difficult to control the two motors together.
        - Are you guys using the encoders?
            - That's the plan for now
            - The MSP430s would handle the encoders and then send it out.
        - How long can the battery last?
            - More than 8 hrs
        - MSP430s have a low power mode that they automatically go into.
        - Draws a constant 500mA; in pulse mode hasn't been measured
            - Measure the mAH that are drawn from the battery when the robot is moving
        - Were the encoders looked at?
            - Yes.
            - Inverted value of RPM would be sent to the beagleboard;
            - At MSP430 level, the time between each rotation will be clocked and stored in registers (series or one that gets refreshed every time?)
                - Something to think about
            - Is distance traveled that critical? You're assuming that you're rolling without slipping. Do you really want to keep track of the linear distance traveled?
                - More important is the speed, and not displacement.
                - How accurate is the GPS? Because you're working within the resolution of the GPS.
                - Work out a few scenarios and test them
            - Encoders: At the wheels, what's being measured?
                - Voltage at degree of rotation
                - What's being done with the voltage?
                    - Detect the time it takes between taking 5 volts and the next time it reaches 5 volts.
                - So you're constantly doing ADD conversions?
                    - No, you can set an interrupt so that when it reaches 5 Volts, it can stop and start going up to 5 Volts again

                - That's a problem, because you might not reach that interrupt again and then the values you're getting are incorrect.
        - You might not even need the encoders, because the gear down is just so large that they might not be required. You have too much torque.
            - One of the points of the encoders is to time the safety system if it's not stopping. In case something fails.
            - Especially because there's no bumper on the back. (it's too expensive)
            - Is it ever going to happen that the wheels will be not moving when they should?
                - No
    - Is there a chance of something coming across and getting stuck in the robot?
        - Yes, but, it's not large, and even if the "halo" gets completed there's always a chance of something getting stuck under the robot
    - With the no bump sensor in the back, there's a huge safety concern.
        - You don't necessarily need a bump sensor like that, there are other methods of getting bump sensors that will retain the safety

➔ Bill of Materials
    - Discussed BOM
    - Instead of the stock aluminum,
        - P11215 has a 12" by 12" by 1" piece of ABS that we can use
    - Get two pumps and reservoirs instead of one, and just replace the one that's currently in the robot.
        - Is better because there is more variation and opening for the amount of space available.
        - Make sure the nozzles are being regulated, because they have a lot of pressure and distance on them.