ENGINEERING NOTEBOOK

NOTEBOOK

NOTEBOOK NO. ______

CONTINUED FROM NOTEBOOK NO. ______ CONTINUED TO NOTEBOOK NO. ______

ASSIGNED TO:

NAME XXXXXX

SIGNATURE ______ DATE ______

DATE ISSUED ______ BY ______

PHONE [redacted] EMAIL [redacted]

COMPANY The University of North Carolina at Charlotte

DEPARTMENT ______

ADDRESS ______

______

CITY ______ STATE ______ ZIP ______

DATE NOTEBOOK COMPLETED ______ NUMBER OF PAGES FILLED IN ______

NOTES:

NOTEBOOK GUIDELINES†

INTRODUCTION

Using a Notebook to record ideas, inventions, experimentation records, observations and all work details is a vital part of any process. Careful attention to how you keep your Notebook can have a positive impact on the patent outcome of a pending discovery or invention.

Following are some overall recommendations to help you keep more efficient and accurate Notebook entries. Remember, however, that these are simply a suggested set of guidelines. Only your attorney can supply the exact guidelines he/she would like you to follow to satisfy specific legal requirements. That is why we recommend that you consult your legal counsel.

RECORDING DATA

Your Notebook is a vital record of your work whether it is for patent purposes, legal records, or documenting development work. The Notebook can help you prove:

a. Exact details and dates of conception
b. Details and dates of reduction to practice
c. Diligence in reducing your invention to practice
d. Details regarding the structure and operation of your invention
e. Test observations and results
f. A chronological record of your work
g. Assignments, meeting notes, requirements, assumptions
h. Other work details

Follow a few simple rules of thumb:

1. Always record entries legibly, neatly and in permanent ink.
2. Immediately enter into your notebook and date all original concepts, data and test results.
3. Record all concepts, results, references and other information in a systematic and orderly manner. (Language, charts and numbering systems should be maintained consistently throughout.)
4. It is acceptable to make your entries brief. Always, however, include enough details for someone else to understand and successfully duplicate your work.
5. Label all figures and calculations.
6. Never, under any circumstances, remove pages from your notebook.

Treat your Notebook as a legal document:

It records the chronological history of your activities. The following guidelines should help you maintain the consistent and accurate entries needed for future legal purposes.

1. Start entries at the top of the first page, and always make successive, dated entries, working your way to the bottom of the last page.
2. After completing a page, sign it before continuing to the next page.
3. Make sure that you record the date of each entry clearly and unambiguously.
4. Never let anyone other than yourself write in your Notebook (excluding witness signatures, discussed later).
5. Never leave blank spaces, and never erase or remove material you have added. Draw lines through any page areas left blank at the same time you are making your entries.
6. Do not erase errors, white-out or obliterate errors or changes. Draw a single line through any erroneous entry, then add your initials and date. Sign and date any explanatory notes or corrected entries.
7. You can supplement your entries with supporting material (e.g., test-result printouts and other documentation). But you must permanently affix the material onto a page in its proper chronological location.
8. Never rely solely on any supplemental attachment. Always include your own entry describing the attachment and add any conclusions that you might draw from its substance.
9. Occasionally, secondary sources might be too large or inappropriate to attach directly to your notebook. In this case, you can add all secondary sources to an ancillary record maintained precisely for this purpose. However, always remember to write a description of these secondary sources, clearly and unambiguously, in your Notebook.

DOCUMENTING PATENT ACTIVITIES

A primary purpose of your Notebook is the support of documenting work that may be patentable. To support patent activities, it is necessary to provide clear, concise, chronological entries with specific dates. To rely on these dates, you must have at least one non-inventor corroborate that the events actually happened and that he or she understood your invention by signing and dating the "Disclosed to and Understood by" signature blocks.

Your Notebook should help you document and prove:

1. *Conception date*—The date that you first thought of and documented your invention.
2. *Date of reduction to practice*—The date that you made a working embodiment of your invention and documented this. This is called "reduction to practice."
3. *Diligence in reducing your invention to practice*— Diligence refers to your intent and conscious effort to make a working embodiment. You are not required to rush, or even to take the most efficient development strategy. However, your Notebook must include details relating to your diligent activities. These are dates and facts that show what activities you have conducted to reduce the invention to practice and when such activities were conducted. Since you may still be diligent despite periods of not working on reducing your invention to practice, always remember to provide reasonable explanations for these periods of inactivity by supplying facts relating to why there was no activity during the period in question.
4. *How to make and use your invention*—Provide documentation details sufficient for a colleague to understand how to make and use your invention.
5. *The best mode of practicing your invention*—Document the best way to practice your invention.

A non-inventor colleague should corroborate each of these events/facts by signing the "Disclosed to and Understood by" on the relevant pages.

† BookFactory provides these sample guidelines "AS IS" without any warranty.

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Group Meeting
Start time: 4:30 pm   Stop time: 5:00pm

- Discussed Senior Design Project
  - Decided on Project Name: Automated Greenhouse

- Brainstorming for Project:
  - will not be an "actual" greenhouse.
  - will have components required for greenhouse and show that they can be controlled and that they work.
  - will NOT have actual plants but artificial ones.
  - will use colored balls to represent the fruit or vegetable.
  - Robot will be mobile with arm attached (research robots and robot arms)
  - Microprocessor: ATMega128 or Arduino - (research) to see which one is better.
  - Best Meeting Days: M, T, W, F, Sat.
  - Research what to monitor in actual greenhouse
    - Temperature
    - Water
    - Humidity
    - Light
    - Ph levels
    - Plant growth
    - Plant color for harvesting
  - Develop timeline
    - Proposal: 1-2 wks
    - Specs: 1-2 wks
    - Research: 1-3 wks (ongoing)
    - Design: 2-4 wks
    - Construction: 4-6 wks (depends on time of parts to arrive)
    - Testing: allow plenty of time (5-7 wks)
    - Report: 2 wks
    - Presentation: 1-2 wks to prepare
    - Oral presentation: 1-2 wks (make changes/practice)

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PROPRIETARY INFORMATION

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Research on Greenhouses Start Time: 12:00PM STOP TIME: 2:00 PM

- How to maintain a greenhouse
  1) Control the temp. by making sure you have the right # of air ducts.
  2) Water your plants adequately
  3) Root out unnecessary plants and grasses
  4) Add sticks and canes on plants that need support.
  5) Maintain the right amount of light
  6) Keep inside and outside of greenhouse CLEAN.

- Things to monitor in greenhouse:
  1) Temp
  2) humidity
  3) Water
  4) CO_2
  5) light
  6) pH of soil
  7) Cooling
  8) heating

- humidity levels 50-70% ⇒ humidity sensors can monitor this.
- temperature: based on plants, can use vents, fans, heaters, shading, tempo sensors can monitor this.
- water: based on plants. Can monitor the moisture in the soil to know when to add water.
- heating: ±25% of heat comes from the sun ⇒ can use a small electric heater for the rest ⇒ avg temp 60°F
- Ventilation: natural ventilation uses roof vent and side inlet vent. Warm air rises to roof ⇒ goes out through top while cool air comes in through side inlet vents.

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Parts Research   Start time: 9:00AM   Stop time: 11:00am

Greenhouse:

- temp. sensors: measure the temp in greenhouse.
- humidity sensors: measure humidity within greenhouse.
- light sensors: measure the amount of light within greenhouse.
- pH sensors: measure the acid level of the soil.
- fertility sensors => check to see if fertilizer is needed for plants.
- moisture sensors: measure how much water in soil
- watering system: system to water plants when needed.

- Sensors have to be monitored by microprocessor
- microprocessor must control watering system.
- need all components to be low voltage => 5 Vdc - 12 Vdc
- Can use relays if more voltage needed => ~~coiled~~ CPM coil rated at 5VDC and contacts at 120VAC.

Robot:

- Robot base w/wheels => must be able to move around
- Color sensor => used to check color of fruit
- camera => also used to check color of fruit
- arm => used to harvest fruit
- touch sensor => needed to measure pressure when grabbing fruit.
- infrared sensor => only used if using line-following robot.

- microprocessor will control all aspects of the robot.
- must have motor with high torque to lift the arm and make it go back and forth.
- base must be able to support the weight of the arm as well as all other components.
- 2nd processor w/wireless options connected to robot.

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PROPRIETARY INFORMATION

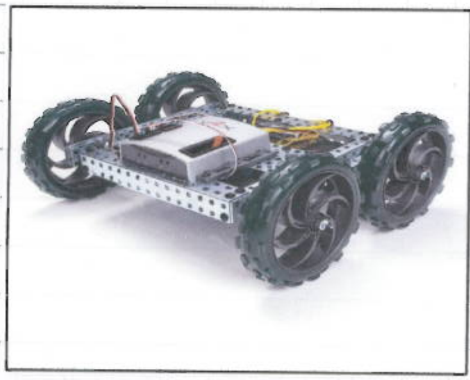
Group Discussion Start time: 4:00 pm Stop time: 5:00pm

- Project was approved => official 1st day of project
  Paul: research parts for robot motion
  Christian: research parts for robot arm
  Shirley: research sensors

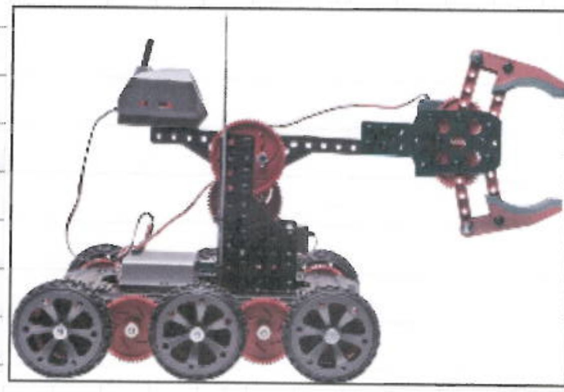
- meeting times: T, F, some on M, W, & Th but not as a group

- Obtained 2 robot bases from Dr. Stephen Kuyath
  1) VEX robot base (Protobot)
  2) Vexplorer Robot base

- Group decided to use VEXplorer base with modifications.



Protobot base



VEXplorer robot

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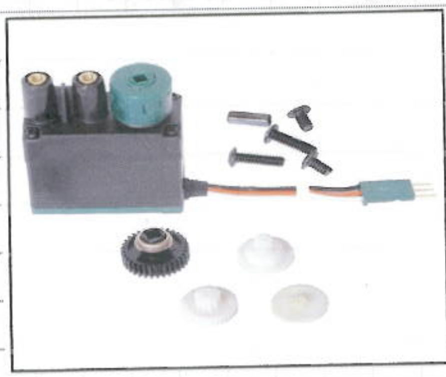
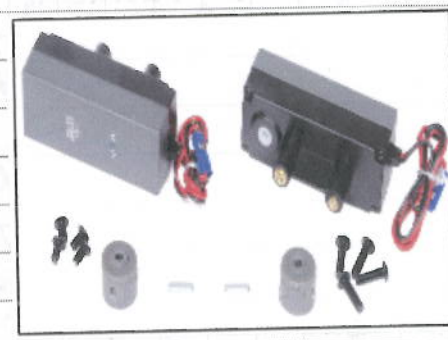
Base Assembly   Start time: 9:30AM   Stop time: 11:00AM

- Took arm assembly off of VEXplorer base
- Took VEXplorer VB-1 motors off => these were DC motors and would require additional circuitry.
- Exchanged DC motors with PWM controlled continuous rotation motor.
- These motors have all circuitry built into the unit. Only requires one wire to controller instead of two.
- Free speed 100 rms @ 7.5 V
- Input voltage: 4.4 - 9.1 V (DC power)
- PWM input: 1ms - 2ms will give full reverse to full forward with 1.5 ms being neutral
- Black wire - ground
- Orange wire - Power
- White wire - PWM signal



Continuous Rotation Motor



VB-1 DC motor

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PROPRIETARY INFORMATION

Moisture Sensor construction, pump test
Start time: 2:00 pm   Stop time: 5:00 pm

- Researched on web for moisture and temperature sensors. Found website called "cheapvegetablegardener.com". Website showed how to make a moisture sensor. The sensor consists of two galvanized nails stuck into a tube like the shape of Plaster of Paris. The materials needed for construction was:

2 - galvanized nails per sensor
1 - box of Plaster of Paris
3/8' plastic tubing cut to 2" per sensor

- How it works: The Plaster of Paris measures soil water tension. When the plaster of Paris is dry it is not possible for electricity to pass between the probes, which are the galvanized nails. As water is added to the soil, more electrons can pass between the probes, reducing the amount of resistance between the probes. By using the range of resistance, you can determine the amount of water that exists in the soil.

- A total of 6 sensors were made but only 3 were usable. This was because we did not let the Plaster of Paris cure long enough. We have to let them set overnight to make sure that the 3 usable ones wouldn't be damaged when we take them out of the plastic tubing.

- Purchased 2 windshield washer pumps from Autozone. Wanted to test pumps to see if they could be used to water the plants. The pumps required 12VDC for operation. The pumps were put into a container of water and power was applied to it.

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- The pump did not work. Checked the voltage going to the pump to make sure it was getting the correct voltage.
- Called the vendor of the pump for a schematic and a spec sheet.
- Vendor would not supply schematic, but did give other info.
- The pumps would not work for our application because of the following:
  1) The pump has to be positioned so that gravity forced water into the pump.
  2) The pump could not be on for more than 7 seconds or it would damage it.

Conclusion: Group decided to use city water with on/off valve and a drip irrigation system.

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Moisture Sensor Test Start time: 9:30AM Stop time: 10:30AM

- Tested one of the moisture sensors
- Measure resistance of sensor when out of water.
  - Measured open circuit across the probes.
- Submersed sensor in a bottle of water.
  - Overload (9:30AM)
  - 23.2KΩ (9:35AM)
  - 17.37kΩ (9:45AM)
- Took sensor out and waited for Resistance to rise
  - 16.4kΩ (9:45AM)
  - 63.5MΩ (9:50AM)
  - 1.1MΩ (10:00AM)

- Soldered headers to breakout boards w/sensors on them.
  - The sensors on breakout boards were then put on a breadboard to keep until more testing can be done.

Sensor list:
- Temp Sensor
- Color light sensor
- Digital Temp Sensor
- Humidity sensor
- Force touch (pressure) sensor

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PROPRIETARY INFORMATION

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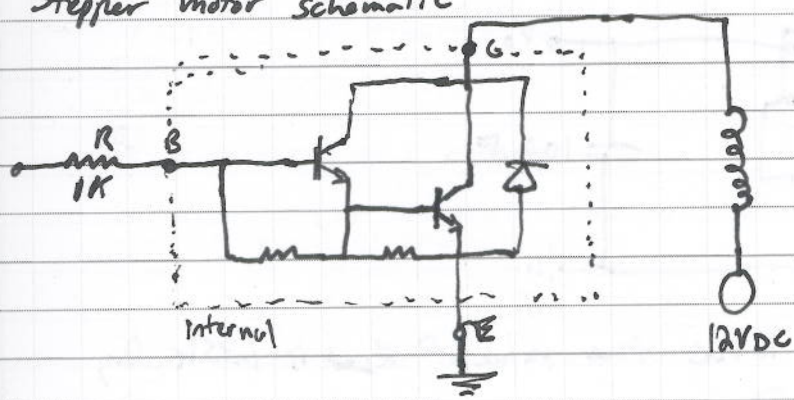
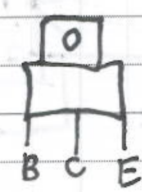
Arm Movement Start time: 2:00pm Stop time: 7:00pm

- Color code for Stepper Motor
  - Green - A
  - Brown - $\overline{A}$
  - Red - B
  - White - $\overline{B}$
  - Black - Ground

Stepper motor schematic





- Need 4 of these circuits for each winding on stepper motor

- Stepper Motor specs
  - Model: ST-03
  - Input: 12VDC
  - Current: 0.16A (160mA)
  - Size: 1.70"D x 1.125"H
  - Unipolar 5 wire
  - 3.6 degrees per step
  - Weight: 235g

- Needed to step the battery voltage of 4.8 VDC up to 12VDC to power the stepper motors. Purchase adjustable boost ~~converted~~ CPM converter from Digi-Key for $24.00

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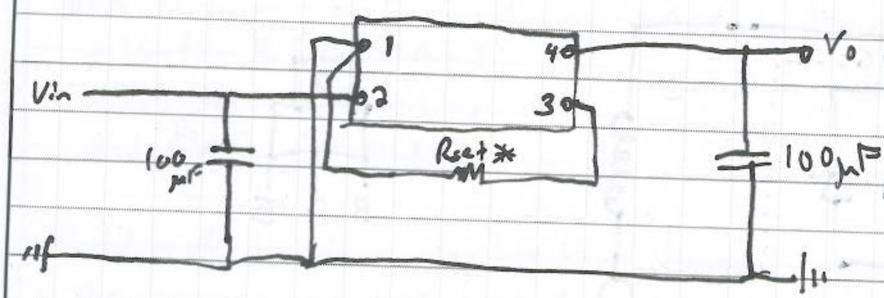
Boost Converter features
Inputs: 2.95 - 5.5VDC
Outputs: 5 - 15VDC
Output Power: Up to 12W
Output current: at 12VDC, 1A
at 15VDC, 800mA

- Standard Application:



* Rset determines Vout. For 12VDC the value of Rset is 1.35kΩ, and for 15VDC, Rset is 60Ω.

- Had James Avery drill holes in bottom of two 3/8" x 3' thread rod. The hole had to be big enough so that the shaft of the stepper motor could be inserted. A hole was drilled through the threaded rod and the motor shaft. A cotter pin was inserted through the hole to secure the shaft to the threaded rod. The stepper motors were attached to the base with wire ties. Paul Drehs wrote a code to test the stepper motor.
- One motor was tested for proper spin direction. The test was a success. We were able to change speed and direction
- The stepper motors did not have a lot of torque. Measured voltage and found that the Voltage was only 8.64 Volts.

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Added a 100 Ω resistor in parallel with a 1.35k Ω resistor to produce voltage of ~~18.~~ 14.89 V. This provided more torque.

Code for Stepper motors:

```
// Timer 0 overflow interrupt service routine
ISR(TIMER1_OVF_vect)  {
static unsigned char phaseSelect = 1;
static char noRepeat = 1;
// Reinitialize Timer1 value
TCNT1H=(65000) >> 8;
TCNT1L=(65000) & 0xff;

if (singleStep == 1) noRepeat = 0;

if (direction == forward && running) phaseSelect++;
else if (running) phaseSelect--;
else if (direction == forward &&  singleStep == 0 && noRepeat == 0)
        {phaseSelect++;noRepeat=1;}
else if (singleStep == 0 && noRepeat == 0)
        {phaseSelect--;noRepeat=1;}

if (phaseSelect > 4) phaseSelect = 1;
else if (phaseSelect == 0) phaseSelect = 4;

switch (phaseSelect * release)
        {
        case 0: stepperMotor = released;break;
        case 1: stepperMotor = phaseAB;break;
        case 2: stepperMotor = phaseBC;break;
        case 3: stepperMotor = phaseCD;break;
        case 4: stepperMotor = phaseDA;break;
        };
}
```

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Group Meeting: Start time: 1:00 PM Stop time: 3:00 PM

- Spoke with Dr. Novas on a way to detect magnetic field by use of an inductor.

- Novas supplied us w/ E-field imaging device. Part no: MC33794
- Told us to do researched & see how it worked.
- Device can generate an electric field and measure it.
- Upon more research, found that device will NOT work.
  - Needed device that will generate field while stationary
  - Another device that can detect field while mobile.
  - Device did BOTH, but could not be disassembled.

- Tried experimenting with made inductor and resistor, but results were inconclusive, Need more research.

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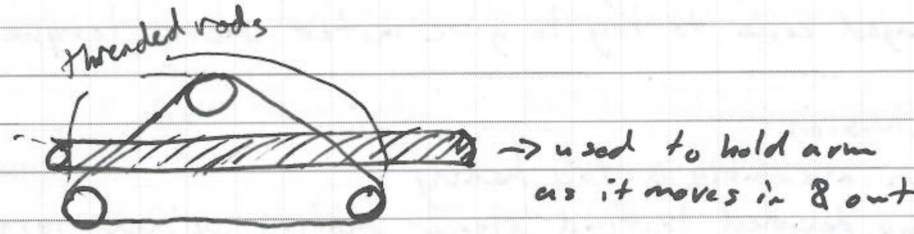
Arm Assembly Start time: 2:00 PM Stop time: 4:00PM

Group meet to decide on arm assembly. Two threaded rods will move arm up & down. Rods would be attached to stepper motors. A third non-threaded rod will attach to the rear center of the robot for stability & support. The arm assembly used two threaded couplings for the threaded rods and one non-threaded coupling for the support rod. The arm assembly was welded and shaped into a triangular shape w/bracket to hold the arm.



- The bracket was set aside. The threads within coupling were damaged during welding. There was resistance when rods were inserted into coupling. Used WD-40 to lubricate them. It was easier to turn, but still had resistance. Decided to use 3/8" tap on the threaded couplings. This was to re-thread couplings to allow rods to turn easier.

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