UNIVERSITY OF HOUSTON
COLLEGE OF TECHNOLOGY
DEPARTMENT OF ENGINEERING TECHNOLOGY
COMPUTER ENGINEERING TECHNOLOGY PROGRAM

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The Plant Protector

Team # 8

Team Members:
Mustafa Khan (mkhan21@sbcglobal.net)
Thanh Vu (vushublu@yahoo.com)
Syed Ali (stali@mail.uh.edu)
Pramod Shrestha (plal_99@yahoo.com)

Project Advisor:
Dr. Farrokh Attarzadeh

COLLEGE OF TECHNOLOGY
University of Houston

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INTRODUCTION

- According to Organic Gardening, when outdoor temperatures fall below 30 degrees F, plants are not safe outdoors. However, for demonstration purposes the program is setup to initialize retraction when temperature falls below 20 degrees C and come back out at 28 degrees C.
- The Plant Protector has been built so it can help plant owners safely keep their expensive and sensitive plants out in the freezing weather.
- The Plant Protector is powered by a 12Volt DC Window Regulator motor.
- The project has been built and will use the Atmel 8051 microcontroller which will be activated upon change in temperature read by the DS1620 Temperature Controller.
- The project was divided into three main parts: Mechanical/Hardware/Software and was integrated together at the end upon completion of both parts.

Background

- After researching the market, Team 8 found nothing exactly like The Plant Protector out in the market.
- Team 8 set three basic requirements for the completion of the project. The project has to be:

  1. Inexpensive
     - To attract customers looking for a bargain.
  2. Dependable
     - So the customer will be satisfied with their purchase.
  3. Efficient
     - So the customer can keep their plants safe and and the project performs its tasks properly.

Background (cont..)

Problems encountered

- Ineffectiveness of the gear motor
- Type of door which will be used
- How the door will open/close
- Running the motor with switched polarities

PRODUCT REQUIREMENTS

Mechanical Design

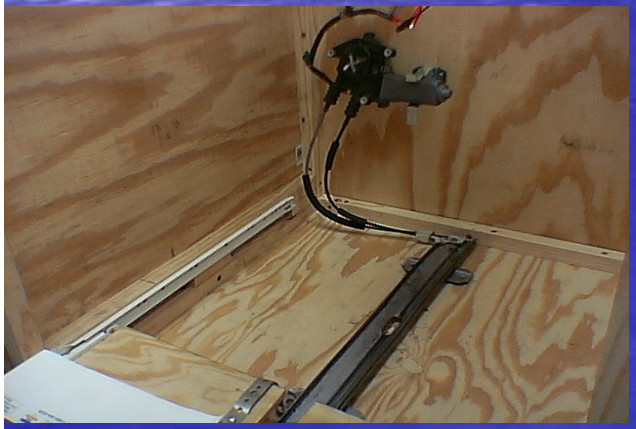
- 2’x2’x2’ Wooden enclosure frame to house the plant.
- Plexiglass top (2’x2’) to let light in
- 19’x19’ flowerbed which is able to slide in and out through the use of cabinet rails that are mounted inside the enclosure.
- A 12V window motor with an attached pulley system to power the operation of the flowerbed.
- A split front door design that will open when the flowerbed slides out, and close when the flowerbed reverses.
- Bungee cords attached to the bottom of flowerbed to help retract the front doors when the bed slides inside.

Mechanical Design

Wooden enclosure

Plexiglass top

Bungee cord



Window motor w/ pulley system

Split front door

Product Requirements (cont..)

Hardware & Software

Amtel AT89C51ED2 Microcontroller use to control all the functions of the components listed below:

- A DS 1620 digital temperature sensor (See Figure 1)
- A LCD screen to display current temperature (See Figure 1)
- Custom built circuit board to interface with ATMEL 89C51 microcontroller, a motor and A digital temperature sensor (See Figure 2)
- Circuit board consists with two DPDT 5 Volt DC relay and two IRFU024N Power MOSFET (See Figure 3)
- 12V dc battery (See Figure 4)
- Custom written C language program. This program is written using Micro-IDE SDCC compiler. Compiled on windows ME operating system.

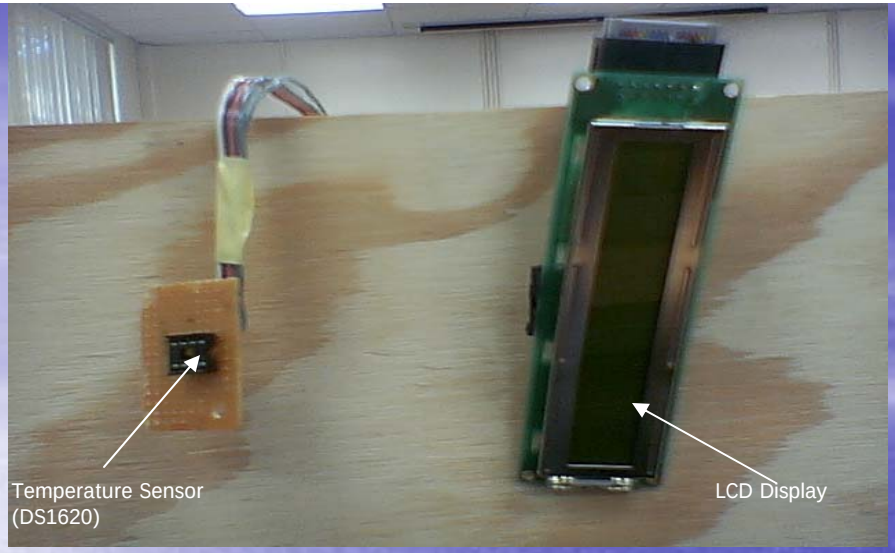


Figure 1

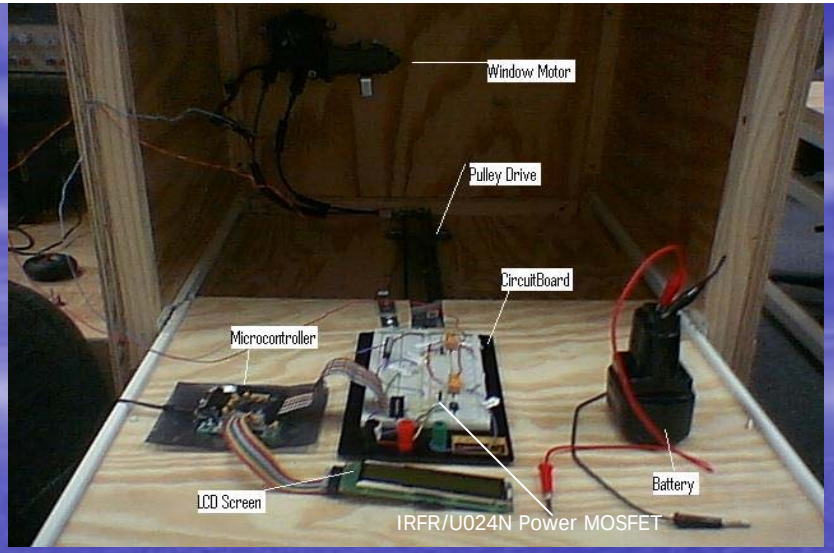


Figure 2

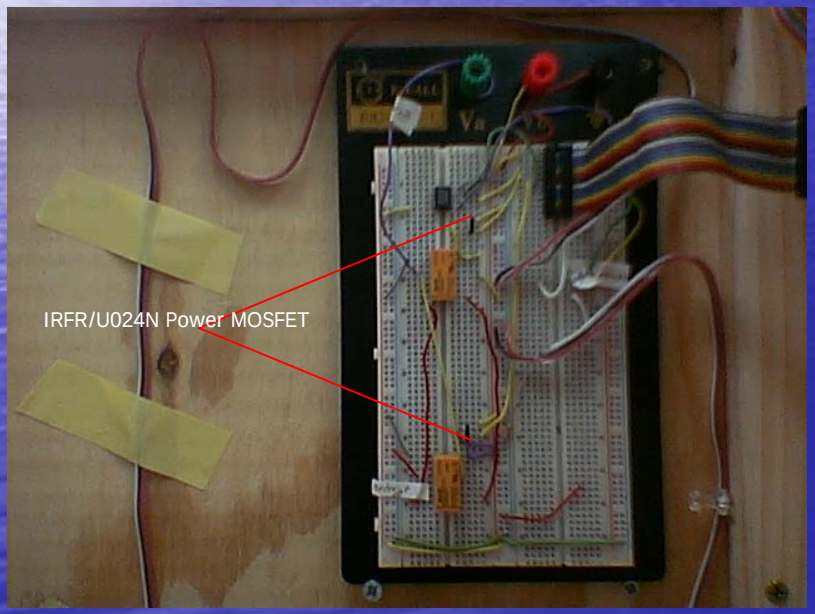


Figure 3

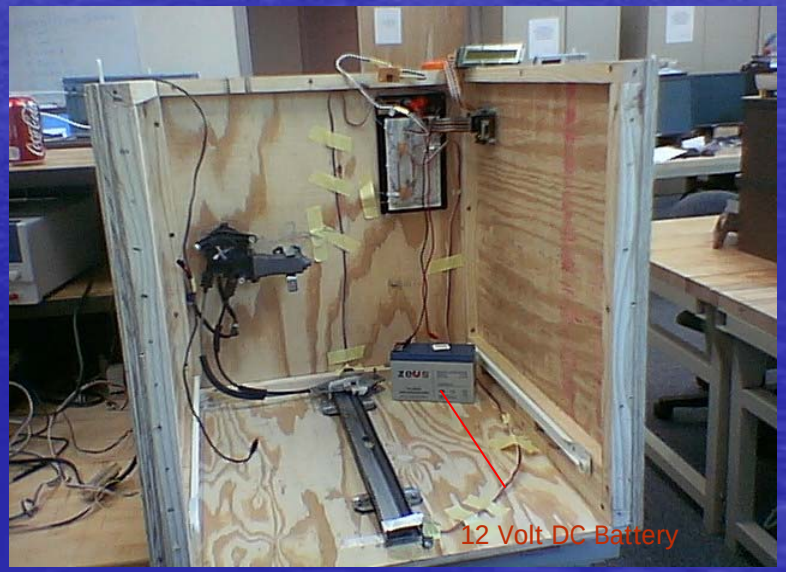


Figure 4

Design Alternatives

Since the team had several design requirements to meet (mechanical/hardware/software), it was in the best interest to choose a simple mechanical design that would also provide the best functionality for the Plant Protector.

- By doing this, the team was able to “not” complicate the electrical design and keep the software code to a bare minimum.
- It also gave the team amble amount of time to construct, and troubleshoot any problems in the design process of the Plant Protector.
- This would yield to a prototype unit that would be durable, reliable, cost effective, and open for new upgrades/modifications.

Design Alternatives (cont..)

Listed below are some alternatives the team took into consideration but not implemented.

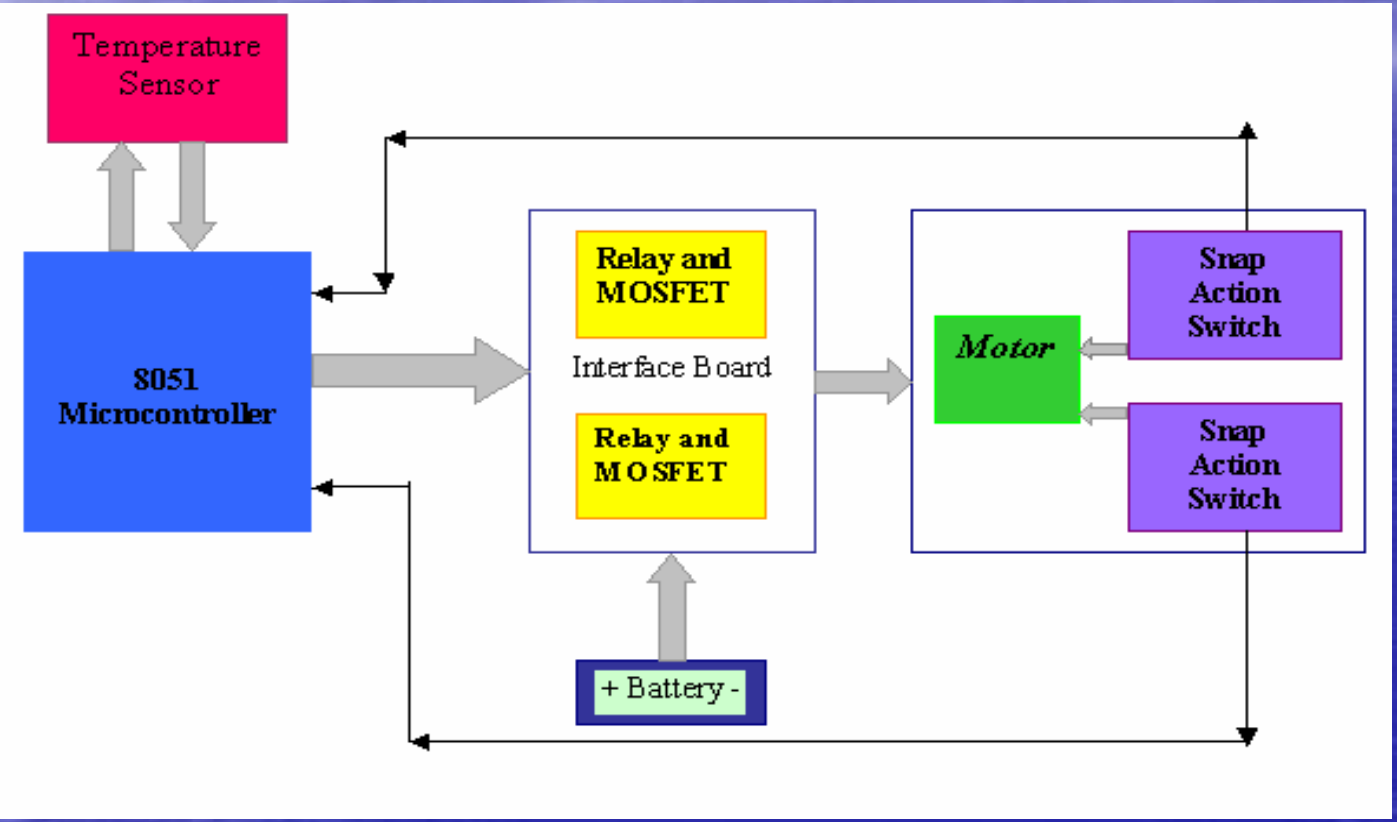
- Flowerbed to be powered by 2 dc gear motors
- 1 front panel door that would open and close and also powered by 2 gear motor.
- Use of analog temperature sensor instead of digital sensor.
- Use of single pole double throw 5 volt dc relay instead of double pole double throw 5 volt dc relay with power MOSFET.

Design Alternatives (cont..)

Why they were not implemented:

- A lot of power consumption and a very large circuit and software code.
- Team wanted a “1 motor 2 function design” which means the window motor provides the power to slide the flowerbed in and out which would in turn open and close the front doors.
- If analog sensor used, more coding would be needed to convert from ADC (Analog to Digital Converter) to DAC (Digital to Analog Converter)
- If single pole double throw relay used, this would require extra circuit and extra battery to run the motor. So time and cost was the factor here.

DESIGN SPECIFICATIONS

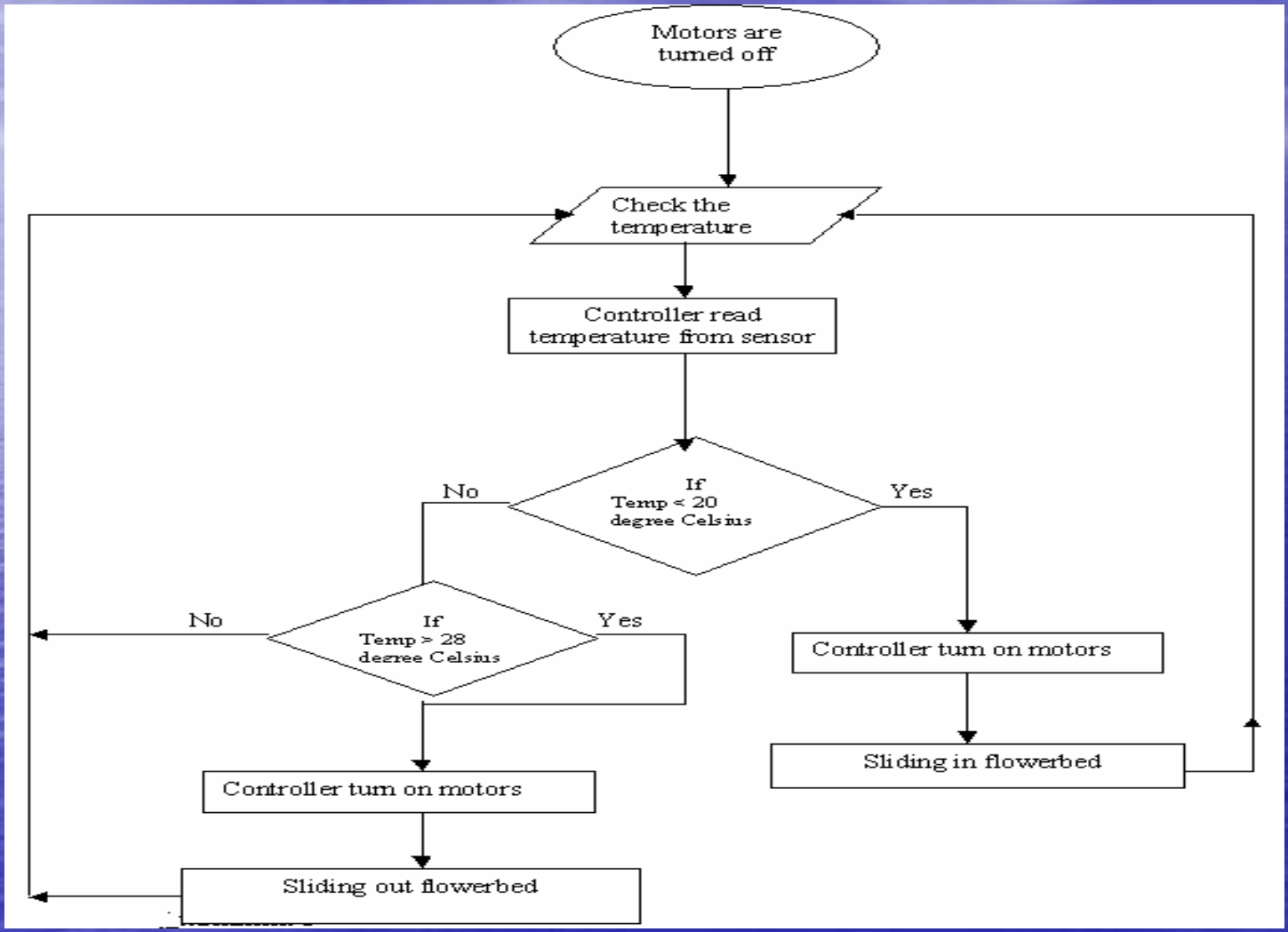


Block Diagram of the Plant Protector System

DESIGN SPECIFICATIONS (cont...)

- Temperature Sensor (DS1620):
  - Reads outside and sends data to microcontroller
- Microcontroller:
  - Reads temperature, displays the temperature on LCD, and controls relays to turn the motor clockwise and counter clockwise
- Relays:
  - The relays control the motor and help to supplies 12 Volt power from the battery
- Motor:
  - Motor with pulley system slides the flower bed in and out
- Snap Action Switch:
  - Stops the running motor after the flower bed sliding in and out is complete
- Battery:
  - Supplies power to run the motor

DESIGN DESCRIPTION



The flow chart of the Plant Protector system.

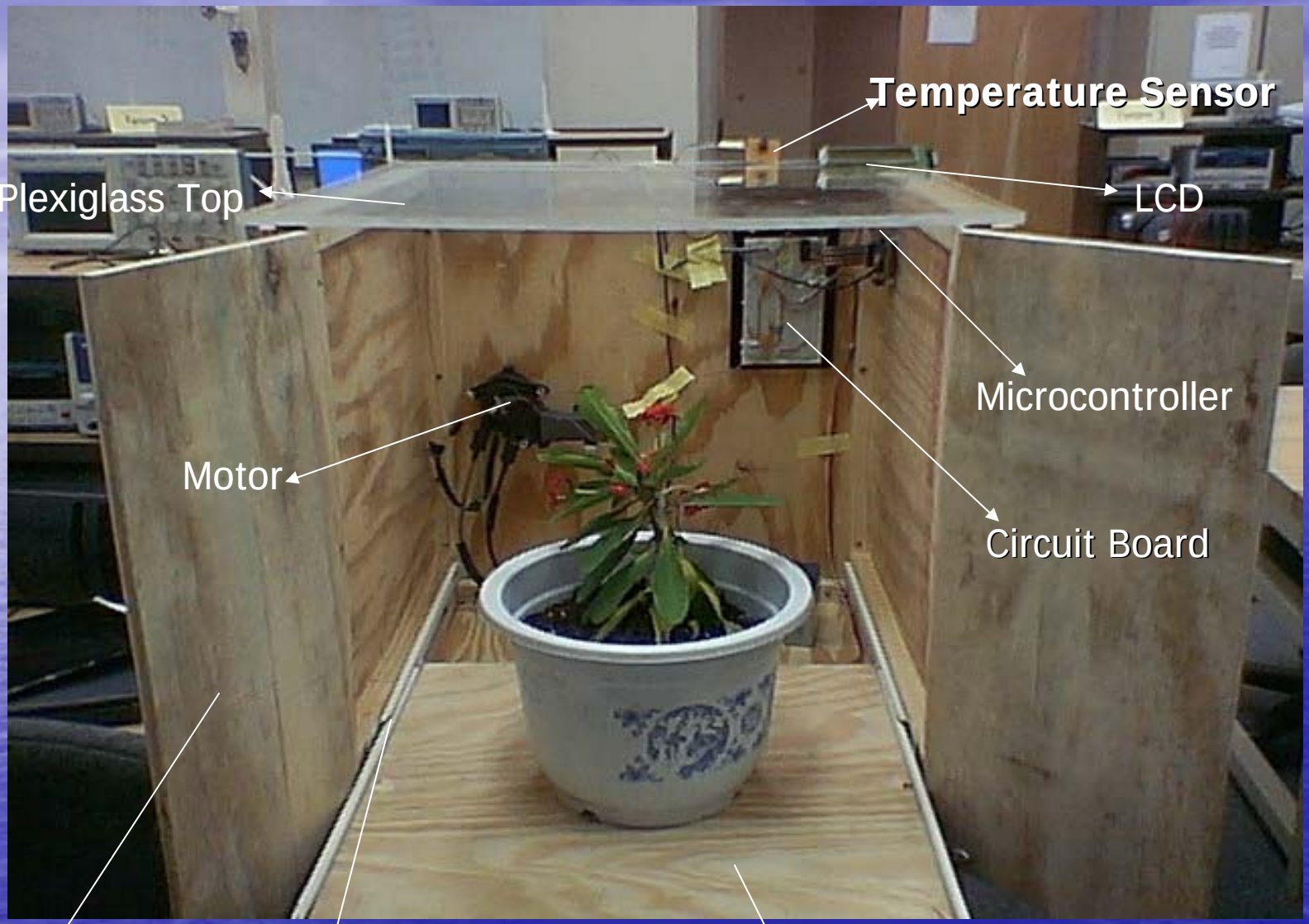
DESIGN DESCRIPTION (cont..)

- The temperature sensor DS1620 will read the outside and send that data to the microcontroller.
- Microcontroller reads temperature and displays on LCD
- If the temperature<20 degrees celsius, the microcontroller will send a 5V signal to the MOSFET and the relay will activate the motor and retract inside. The process will reverse when the Temperature>28 degrees celsius. The snap action switch will turn off the motor once it has been triggered by the flower bed.
- Opening of the flower bed door is done by pushing action of the flower bed sliding out.
- Closing of the flower bed door is done by pulling action of the attached strings between the doors and the flower bed when the bed is sliding in.

Construction Details

- Build the enclosure
- Install motor and pulley system
- Attach pulley system to the flowerbed
- Build circuit board
- Install circuit board and manually test it with motor
- Install all peripheral hardware (temp sensor, LCD, battery)
- Software written then downloaded into microcontroller
- Microcontroller installed and test the functionality of the Plant Protector.

Front View of the plant protector



Cost Analysis

- In order to determine the actual cost of the project, the team 8 had evaluated the parts that had been used towards the production of the final product.
- The team had taken three important factors to determine the cost of the project, and separated the amount in three different tables and computed the total cost to be **$6,833.28.**
- The cost analysis performed by team 8 is basically based on equipment cost, labor cost and the Lab usage cost which is shown in the following tables below.

Cost Analysis

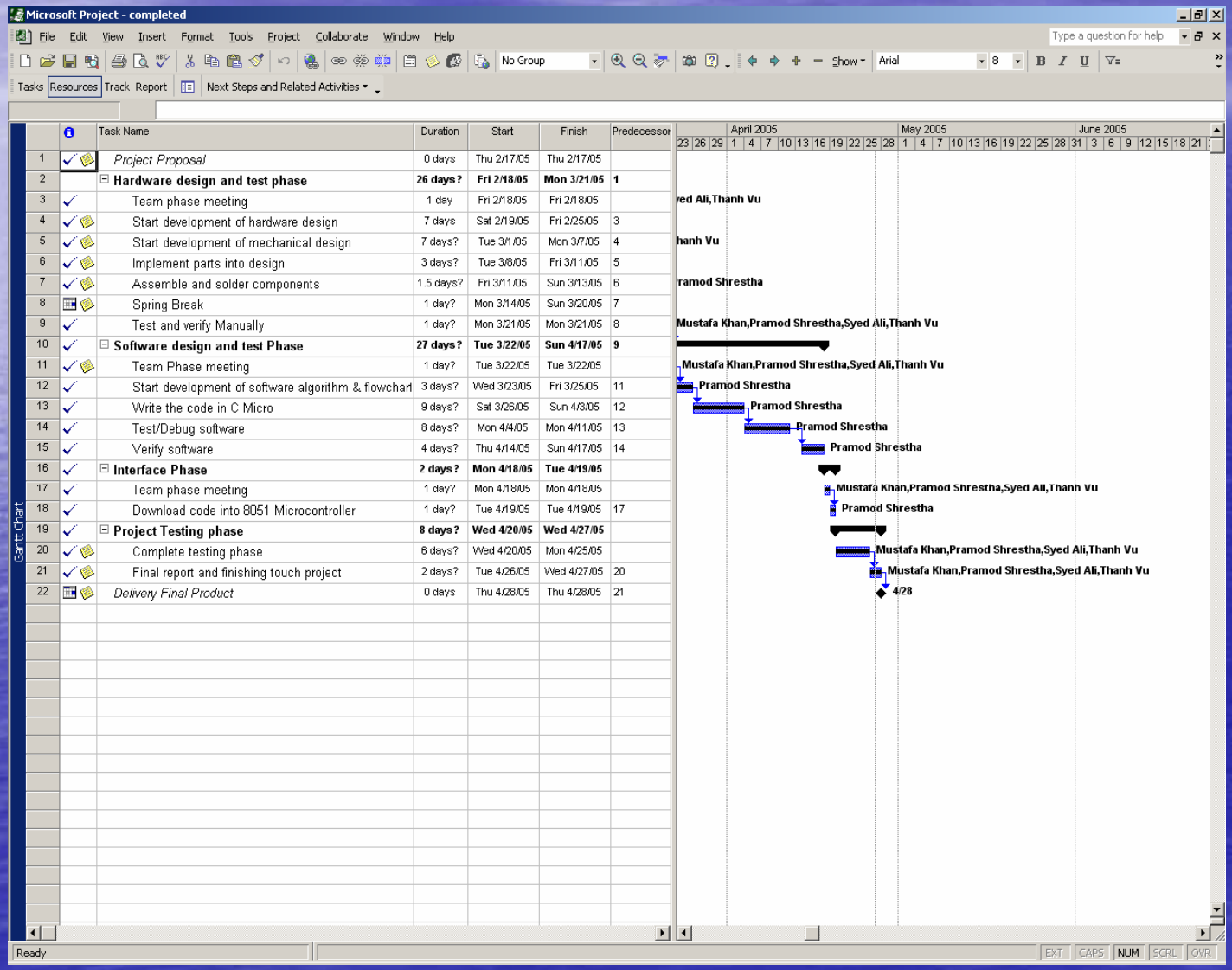
Equipments	Qty	Price	Source
Microcontroller	1	$70.00-	UH College of Tech
Cable-BR	1	$6.00	EPO
LCD display	1	$7.95	Lab Inventory
Temperature sensor	1	$11.24	Jameco
Windows Regulator	1	$24.00	Astro Auto Parts
12 V dc Battery	1	$16.50	EPO
Snap Action switch	2	$6.00	EPO
Relays	2	$5.90	Donated
Power MOSFET	2	$5.90	Donated
Resistor	2	$0.20	Lab Inventory
Breadboard	1	$10.00	Lab Inventory
Wood (2'x2')	4	$16.00	Donated
Hinges	2	$2.00	Donated
Plexi Glass	1	$30.00	Donated
Super Duster	1	$7.95	EPO
4CON wire	1	$4.64	Radioshack
Miscellaneous	1	$25.00	EPO & Lab Inventory
Total		**$249.28**	

Cost Analysis (cont...)

- The total hours invested by the group is 124 hrs and each individual invested 31 hrs towards the completion of the project
- The dream salary of each individual will based on the hourly rate of $20.00.
- $20.00 * 2.5 * 31hrs = 1550.00.
- Each Team member was charged $96.00 for the whole semester, from here the team calculated the amount to be $384.00.
- The total estimated labor cost on the project will be $6200.00

Project Cost	Amount
Salary of the labor	**$6,200.00**
Cost of the Equipment	**$249.28**
Lab Usage Fees	**$384.00**
Total	**$6,833.28**

Gantt Chart for team 8



Project Schedule

- February 18 - Hardware design and test Phase.
- March 1 - Mechanical Design
- March 8 - implements parts into design
- March 11 - Assemble and solder components
- March 21 - Test and verify manually
- March 22 - software design and test phase
- March 23 - start development of software algorithm & Flowchart
- April 4 - Test/Debug Software
- April 14 - Verify and test the software
- April 18 - Interface the circuit with the microcontroller
- April 20 - Project testing phase
- April 26 - Final testing phase and completing the final report
- April 28 - Delivery of the final Product “The plant Protector”

Conclusion

- The team members demonstrated the idea of a prototype, automated cold frame storage unit as our senior project.
- Team 8 has accomplish its goals of developing a prototype cold frame unit, to store a potted plants under freezing weather conditions.
- The main purpose of this unit is to automatically store a plant in the cold frame during the freezing temperature and then release the plant when the temperature rises.
- It will providing an alternative for gardeners to protect their plants automatically depending on the weather conditions.
- Therefore the automated device The Plant Protector can protect expensive plants providing suitable environment for the plants under freezing conditions.

The Plant Protector: References

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Thank You Very Much for Your Time and Attention.

Questions & Comments?

PROJECT DEMONSTRATION