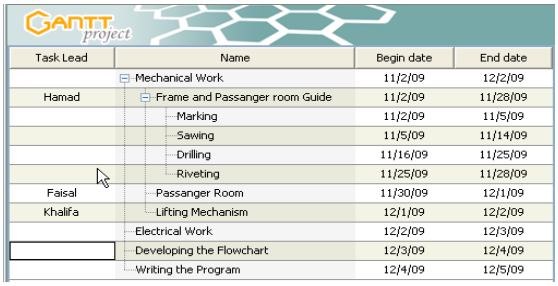
ثانوية التكنولوجيا التطبيقية
Applied Technology High School

Engineering Project-I

Module 4
Project Planning



Task Lead	Name	Begin date	End date
	Mechanical Work	11/2/09	12/2/09
Hamad	Frame and Passanger room Guide	11/2/09	11/28/09
	Marking	11/2/09	11/5/09
	Sawing	11/5/09	11/14/09
	Drilling	11/16/09	11/25/09
	Riveting	11/25/09	11/28/09
Faisal	Passanger Room	11/30/09	12/1/09
Khalifa	Lifting Mechanism	12/1/09	12/2/09
	Electrical Work	12/2/09	12/3/09
	Developing the Flowchart	12/3/09	12/4/09
	Writing the Program	12/4/09	12/5/09

PREPARED BY

IAT Curriculum Unit

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Module 4
Introduction to Project Planning

Module Objectives

Upon successful completion of this module, students will be:

- State the six different stages involved in project work;
- Prepare a project plan, by following the six different stages described for the water level control system project.
- Select a project from the list of choices given, and justify your selection.
- Present the plan for your project in a report format describing each stage by following the template provided.

Module Contents:

4.1 Introduction to the Stages of Project Work

It is important to invest some time and effort in identifying the problem or challenge prior to choosing and designing the project. Investigation, planning, testing and so on, will then follow the project selection. There are different methods in which project work could be carried out based on the situation. Generally, project work would involve the following stages:

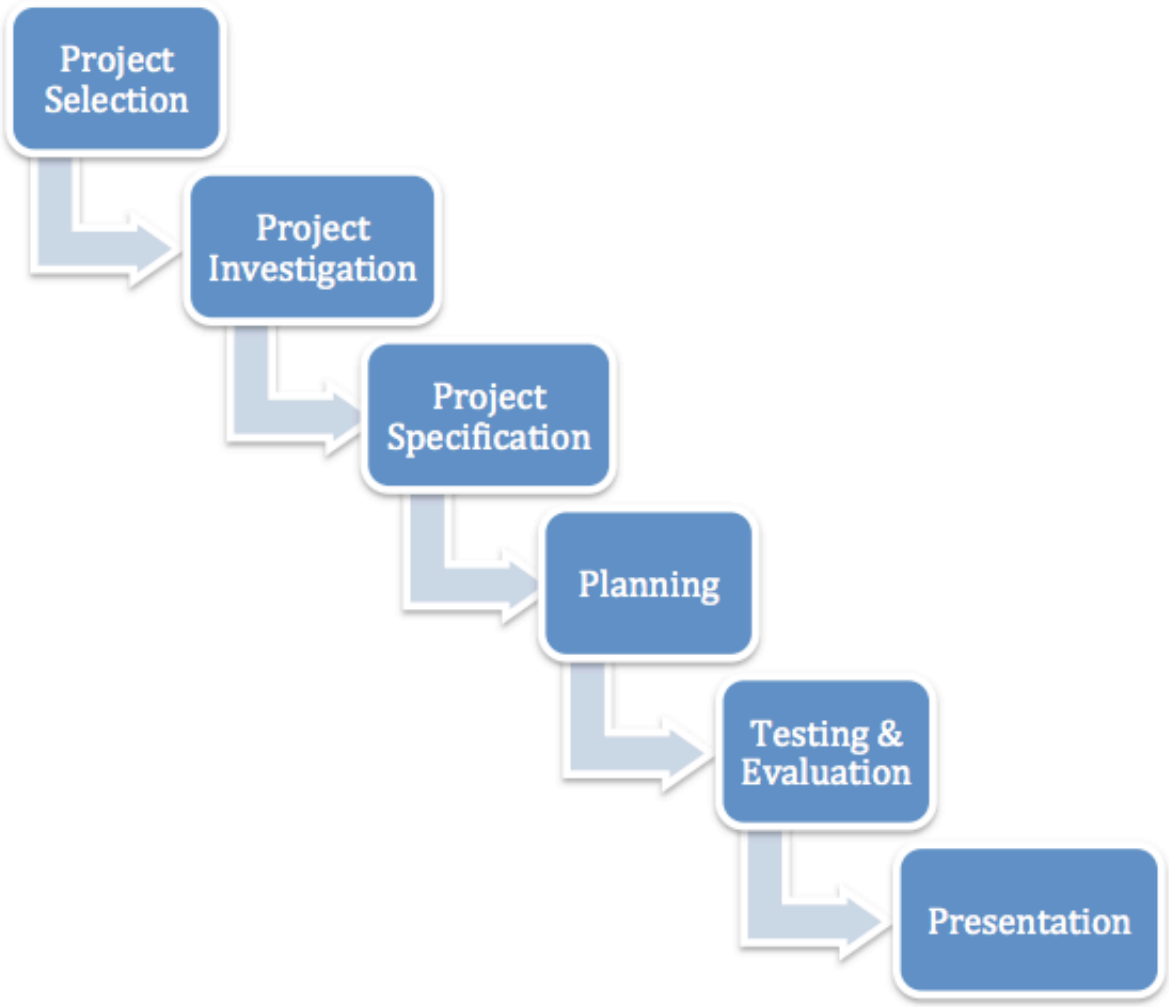


Figure 4.1: Stages of project work

This module will provide an in-depth understanding of the different stages of project work described above through an example of a 'Water Level Control System". The knowledge gained through this experience will help you design and build a project prototype of your choice in term-3.

1. Project Selection

Selecting a suitable project requires identifying a problem by visiting local situations, arranging visits and making contacts with people to know, gathering more information, and identifying project outcomes and related expenses. *Note: This step is required only if you have not been told exactly what to design or if you have not been given a list of choices.*

2. Project Investigation

Begin with the end in mind. Collect information about the project by identifying different sources of information that would be helpful for your research. The research methods listed in figure 4.2 could be used in the investigation process, to come up with answers for the following questions: What kind of people will use it? Where and when will they use it? What features will be useful for them? What are the existing product features? How are other users using it? What are the existing resources that could be used? How much will it cost?

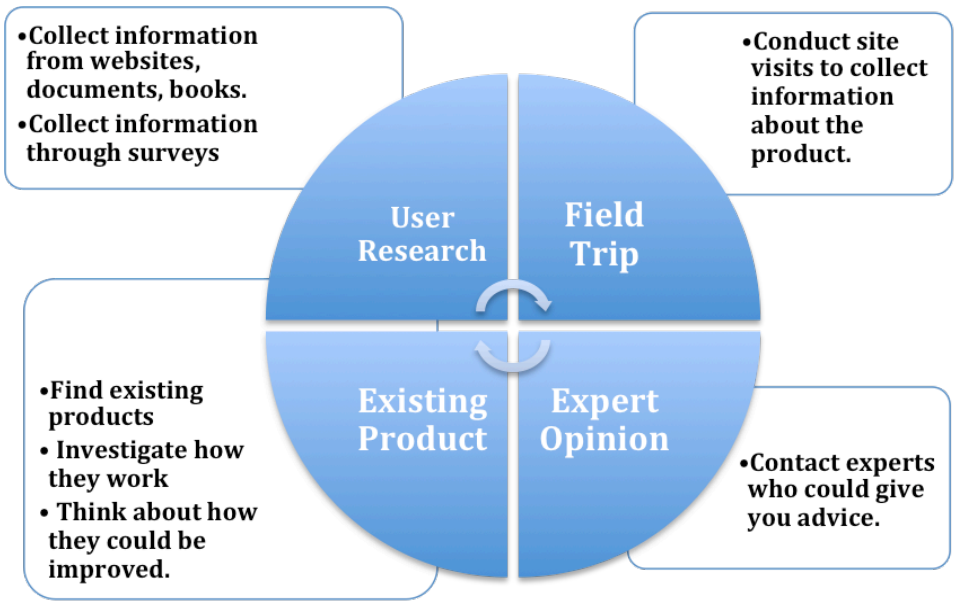


Figure 4.2: Research Methods

3. Design Specification

This part defines the specifications of the design that are fixed or could be changed. The findings from your research should form the basis of your design specification. The specification checklist given below could be used for general guidance. However, more items could be added based on the project requirements.

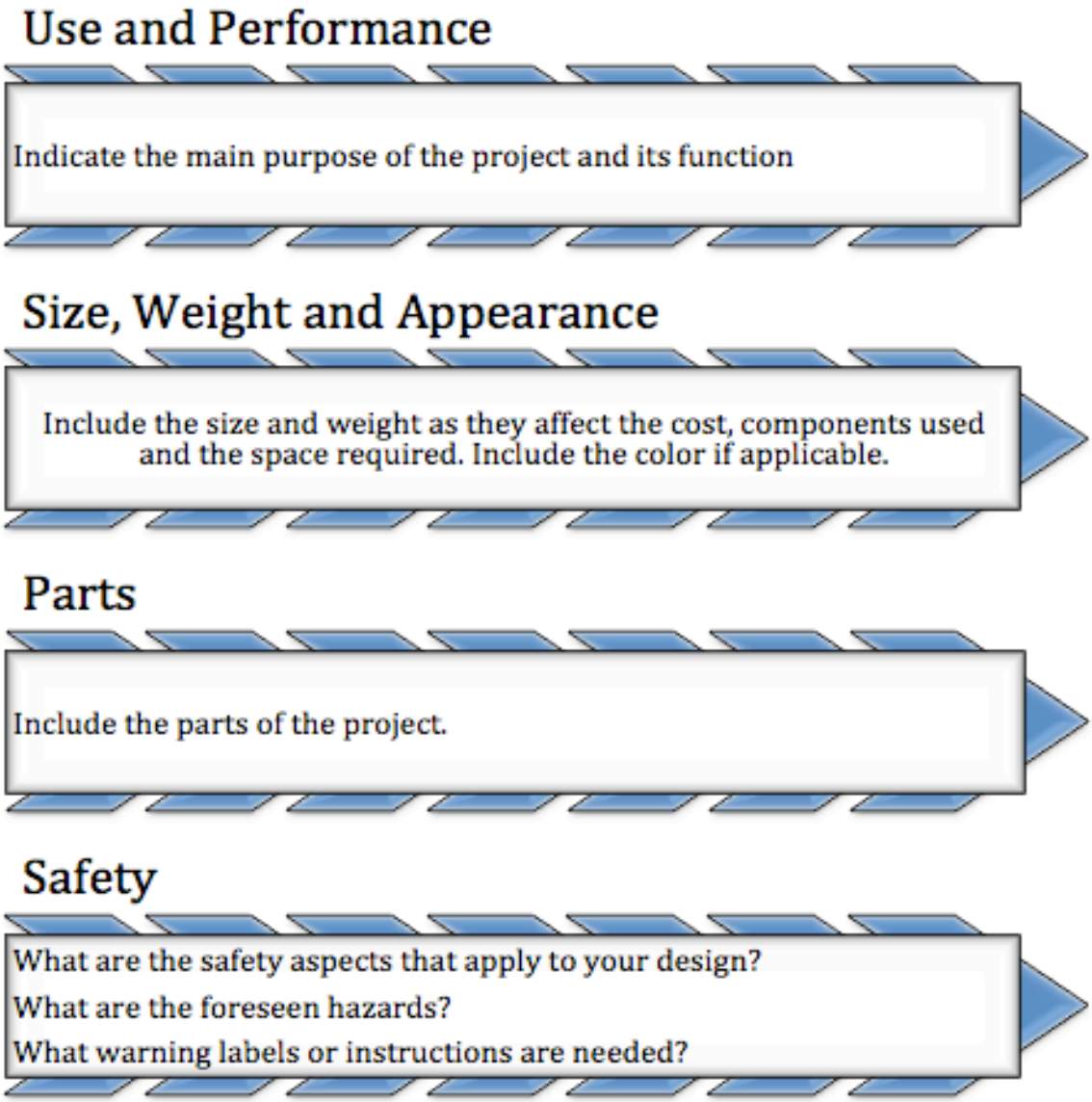


Figure 4.3: Specifications Checklist

4. Planning and Construction

1. Analysis
   a. What is the project challenge?
   b. Will the system control a sequence of operations? What are they?
   c. Is it a closed loop system?
   d. What inputs are required?
   e. What outputs are required?
   f. What type of control does the system need?
   g. Are there any other special considerations?

2. Sketching

   Record your ideas and thoughts. It could be in the form of notes and drawings. The sketches must be clear and must be freehand. Use color and shades and include notes in your sketch to explain your ideas.

3. System Diagram

   Draw system diagrams to show the sub-systems (input, process and output units) in your design.

4. Circuit Diagram

   Draw the circuit diagram of the system including all the component specifications.

5. Orthographic drawing:

   Use AutoCAD or any other software to come up with a clear drawing of the intended prototype. Mark the exact dimensions and include all details of the design and materials.

6. Production Flowchart:

   Develop a production flowchart including the following:

   a. List the order in which the main parts will be assembled such as procuring materials, marking out, cutting, soldering and so on.
   b. Indicate the time required to complete each task.

A Gantt chart could be used to prepare the production flowchart/schedule to display the project tasks in a sequence and timeline.

5. Testing and Evaluation

The final evaluation phase includes two major aspects:

a. Assessing the quality of your project with reference to the design specifications set initially.
b. The process used while it was designed.

6. Presentation

The presentation stage requires preparing a project report and an appealing keynote/PowerPoint/video presentation. The way you present is important.

4.2 Project Planning Example

This section will demonstrate the 6 different stages involved in planning a project using an example of a 'water level control system' project.

Problem Description: Mark forgets to switch off the water pipe that fills his water tank, and it overflows. As a result he ends up paying a huge amount of money for his water bills. He prefers to be able to regulate the level of water in his tank to make efficient use of the resource.

Solution: An automated system that will regulate the water level in the tank will solve the problem. This system is a closed-loop or a feedback control system. Regulating the level of water in a tank requires sensing the level of water and switching off or switching on the pump to fill the tank. Feedback is important here. Figure 4.4 shows an automated water level controller that uses a transmitter and receiver to detect the level of water and operate the pump. This module presents a simplified version of this system using the BASIC Stamp microcontroller.

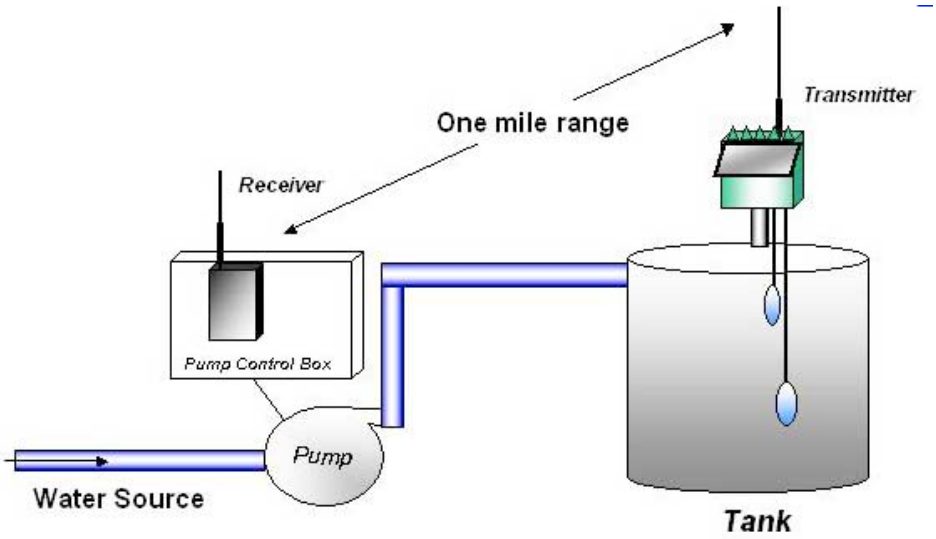


Figure 4.4: Automated Water Level Controller

Objective: To design and build a feedback control system that will regulate the level of water in a tank/container.

Project Selection: This stage could be skipped as the project topic has already been provided.

Project Investigation: Collect information from websites, explore existing products, conduct site visits and contact experts to come up with answers for the following questions

a. What kind of people will use it?

_____

b. Where and when will they use it?

_____

_____

c. What features will be useful for them?

_____

_____

d. What are the existing product features?

_____

_____

e. How are other users using it?

_____

_____

f. What are the existing resources that could be used?

_____

_____

_____

g. How much will it cost?

_____

_____

_____

Design Specification

- Use and Performance: The main purpose of the project is to regulate the water level in a tank or a container. The conductivity sensor is used as a level detector and the water level is regulated by turning on and off the pump based on the feedback from the conductivity sensor. The pump is operated until the water comes up to the level of the conductivity sensor's probe, and then the level is held there, automatically, based on the feedback from the conductivity sensor.

1. Size, Weight and Appearance: *(Include the size, weight and appearance of this project prototype)*

2. Parts:

No	Part	Quantity
1	BASIC Stamp BoE	1
2	IC 555 timer	1
3	Transistor (pnp) BC 547B	1
4	2”, 4-40 stainless steel machine screws	2
5	Water pump	1
6	Cup spanner (a piece of plastic or wood to hold the conductivity sensor)	1
7	9V battery	1
8	Relay (5V)	1
9	Hoses	-
10	Jumper wires	-
11	100 Ω resistor	1
12	10 Ω resistor	1
13	100 k Ω resistor	1
14	10 kΩ resistor	1
15	220 Ω resistor	1
16	0.1uF capacitor	1
17	NO Pushbutton	1
18	Cup, in which a 1⁄4” hole can be punched or drilled near the bottom	1
19	Watertight tray or shallow dish made of glass or plastic	1
20	Duct tape or extra-wide electrical tape	1

3. Safety: (*Include the safety aspects, foreseen safety hazards and warning labels or instructions that could be used for this project)*

_____

_____

_____

_____

_____

_____

_____

Planning & Construction

A. Analysis *(Answer the questions in this section)*

1. What is the project challenge?

_____

_____

_____

2. Will the system control a sequence of operations? What are they?

_____

_____

_____

3. Is it a closed loop system?

_____

_____

4. What inputs are required?

_____

_____

5. What outputs are required?

_____

_____

6. What type of control does the system need?

_____

_____

7. Are there any other special considerations?

_____

_____

B. Sketching *(Imagine, and draw a rough sketch of the prototype in the box provided below)*

C. System Diagram

- A switch (pressed by the visitor) will turn on the circuit.
- The conductivity sensor will provide a feedback to the 555 timer.
- The timer will produce pulses with the required time delay.
- The pulses will turn the transistor driver ON and OFF repeatedly with the set time delay.
- The driver turns the relay ON and OFF, which in turn turns ON and off the pump.

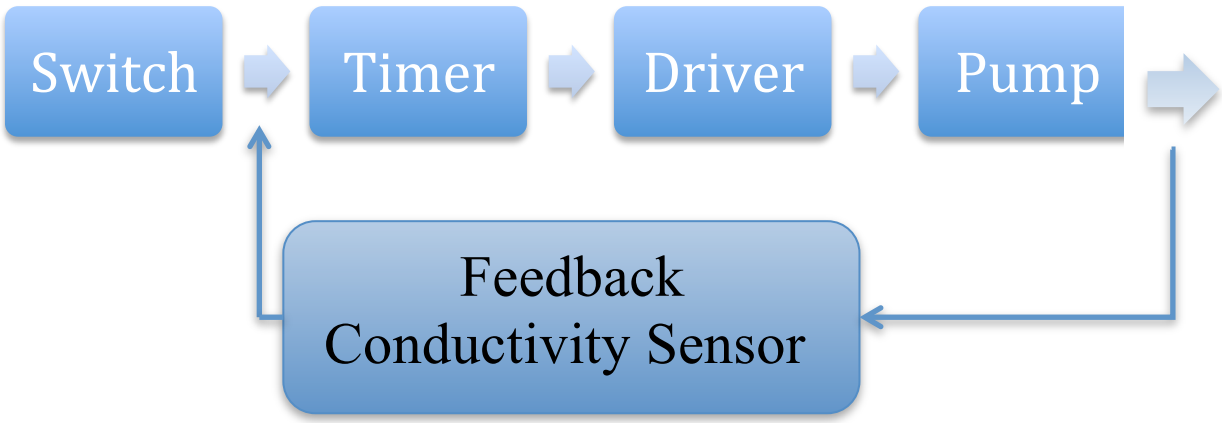


Figure 4.5: System Diagram

D. Circuit Diagram & Construction

i. Preparation of the Pump: Figure 4.6 shows the preparation of the pump.

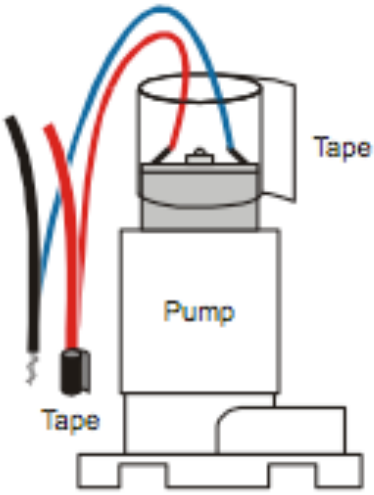


Figure 4.6 : Pump preparation

ii. Preparing the Circuit:

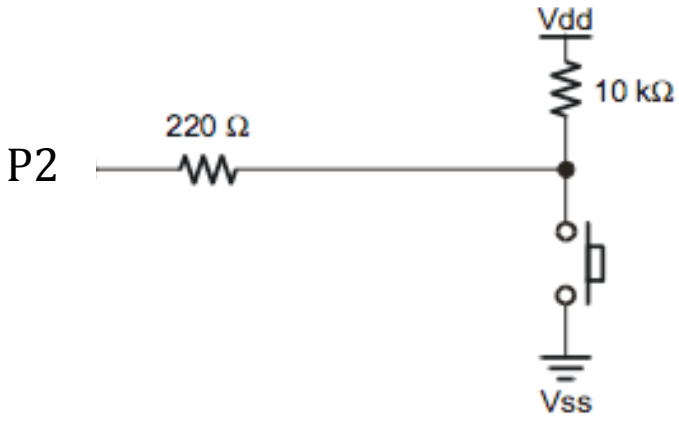


Figure 4.7: Start pushbutton circuit

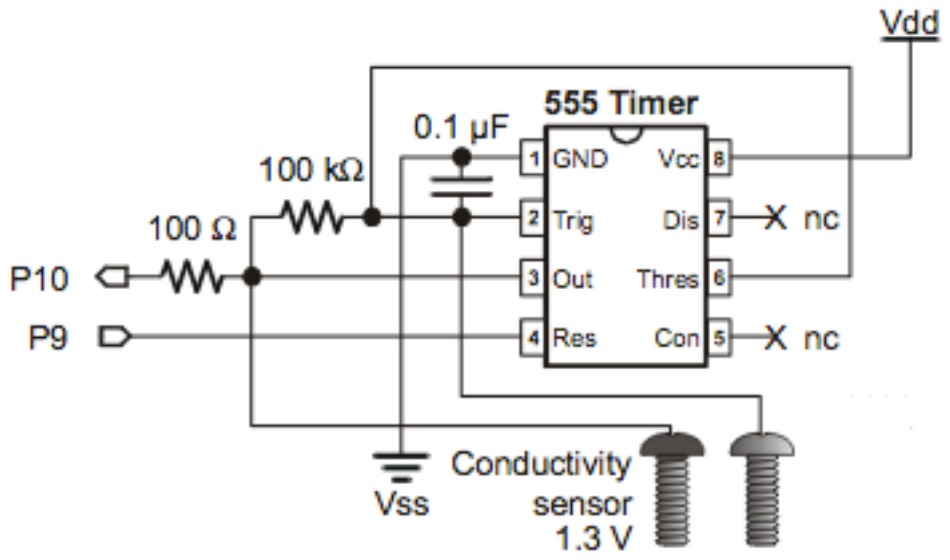


Figure 4.8: conductivity sensor and timer circuit

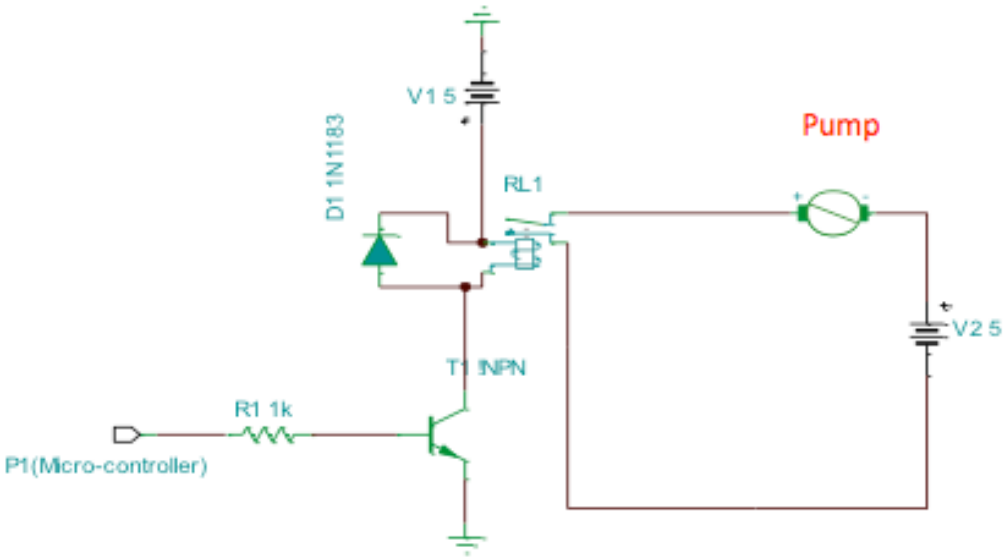


Figure 4.9: Pump Driver Circuit

E. Orthographic Drawing: *(AutoCAD or any other software could be used to come up with a clear drawing of the intended prototype. Note that the exact dimensions need to be marked clearly and all details of the design and materials must be included in the drawing.)*

F. Production Flowchart:

A production flowchart must include the following: List of the order in which the main parts will be assembled such as procuring materials, marking out, cutting, soldering and so on; Indication of the time required to complete each task. Description of the procedure for using the Gantt Project software to prepare Gannt charts is given on pages 18 to 26.

- **Testing and Evaluation**

a. After project completion, the quality of your project must be tested with reference to the design specifications set initially.

b. The process used while it was designed, and the challenges faced must be described along with the description of results.

- **Presentation**

Finally, video/PowerPoint presentation needs to be prepared by describing clearly the stages of construction, and the final results.

4.2.1.Gantt Charts

Project management software often contains **Gantt charts** that graphically display the project tasks and task durations. A typical Gantt chart is shown in figure 4.10.

In a Gantt chart, each task is represented by a separate bar. The top of the Gantt chart displays dates in increments of days, weeks or months, depending on the length of the project.

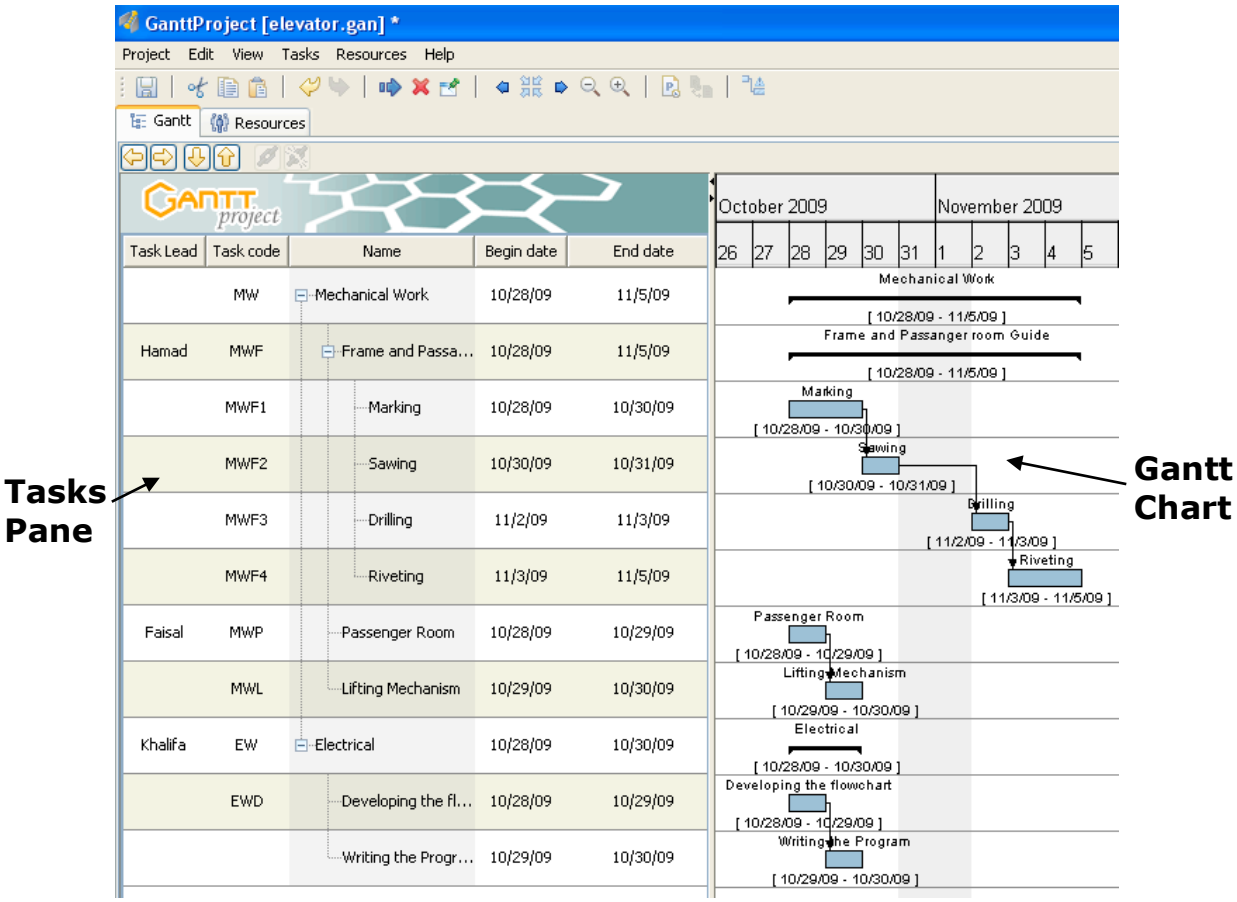


Figure 4.10: A Gantt chart sample.

The task duration is represented by the length of the horizontal bar. The left end of the taskbar marks the task start date and the right end marks the task completion date. Tasks may be performed concurrently, they may overlap, or they may run sequentially if the start of one task is dependent on the completion of another.

4.2.2 Procedure for using GanttProject

This example demonstrates how to create a production flowchart/schedule for an elevator project.

1. Double-click the GanttProject icon to display the GanttProject application window as illustrated in figure 4.11.

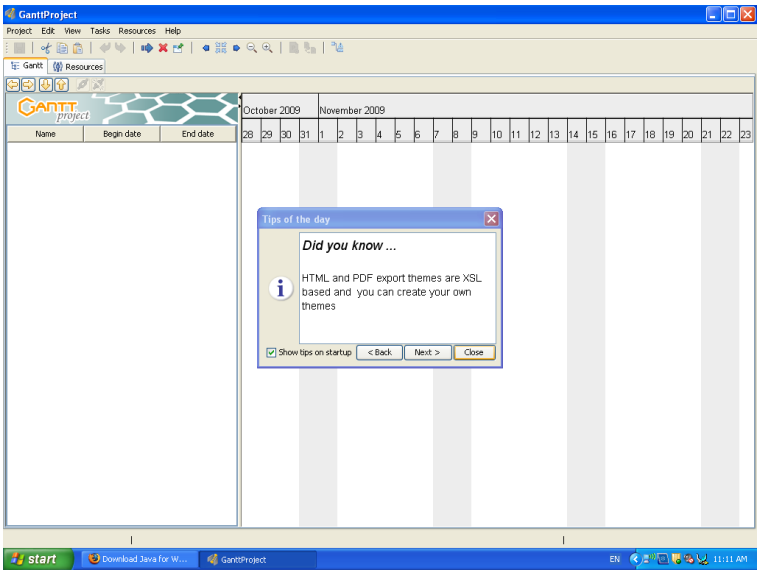


Figure 4.11:GanttProject application window.

2. In the tool bar, click the New Task button to add a task to the tasks pane as shown in figure 4.12.

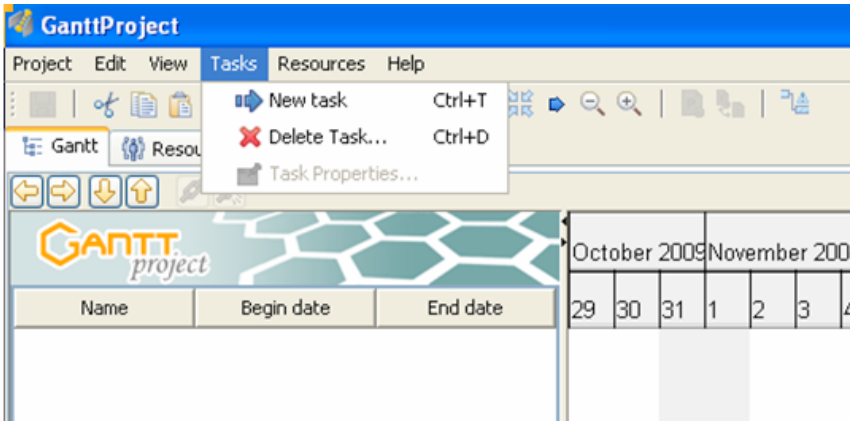


Figure 4.12: Adding a new task.

3. In the Tasks pane, notice that the text in the Name column is selected, enabling you to name the task as illustrated in figure 4.13.

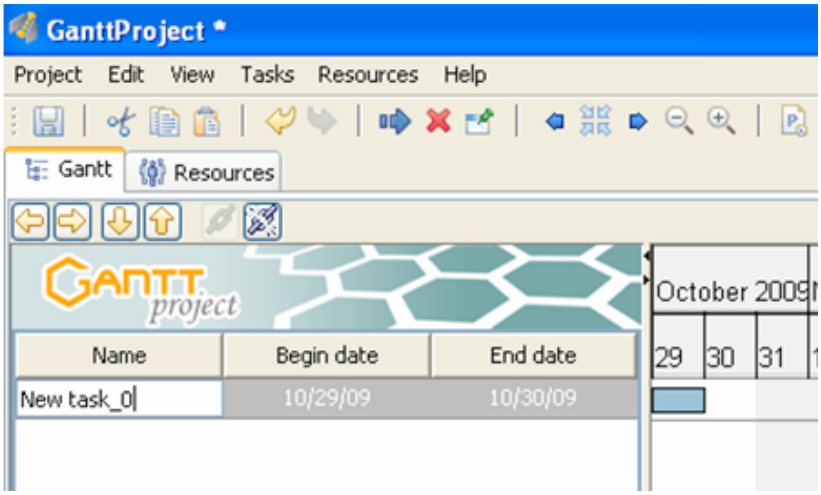


Figure 4.13: The task pane with the name column selected.

Type **Mechanical**, then press **ENTER** to specify the task name, notice also that a task bar appears in the Gantt chart reflecting the task you just created, and that the task start date defaults to today's date.

4. Click the New Task button to add a second task to the Tasks pane. Type ***Frame and Passenger room Guide***, press **ENTER**, and then click the **Indent** button in the Gantt tab toolbar as shown in figure 4.14.

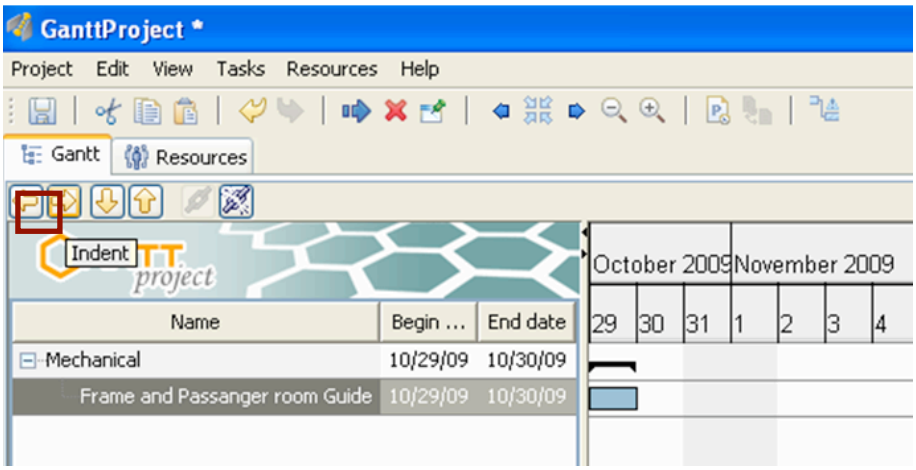


Figure 4.14: The indent button in the Gantt tab toolbar.

5. With the ***Frame and Passenger room Guide*** task still selected, click the **Task Properties** button in the toolbar to display the Properties dialog box as shown in figure 4.15. Notice that the name you specified for the task in step 5 displays in the Name text box.

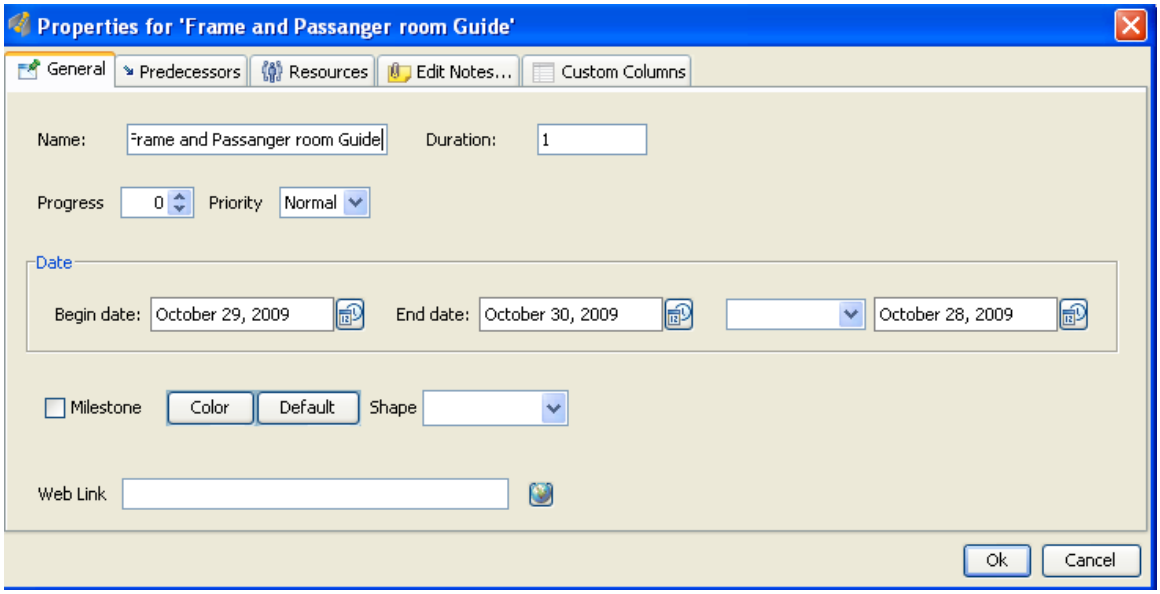


Figure 4.15: Shows a GanttProject Properties dialog box for task.

6. Specify duration of **7** days, and then click **OK**.
7. Click anywhere in a blank area of the Tasks pane to deselect any task.
8. Click the **New Task** button to add a third task and specify a name of ***Passenger Room***, press **ENTER**. With the third task still selected, click the **Indent** button to indent the task and make it the second subtask of the top-level task, **Mechanical Work**.
9. With the ***Passenger Room*** subtask still selected, click the **New Task** button and specify a name of ***Lifting Mechanism***. Notice that when you press **ENTER**, the task automatically displays as a subtask of **Mechanical Work**. This is because the previous subtask was selected when you created this new task.

10. Click anywhere in an empty area of the Tasks pane to deselect any tasks, then click the **New Task** button. Specify a name of **Electrical Work**, and then press **ENTER**. Notice that because no task was selected and you did not click the **Indent** button, this task did not become a subtask of **Mechanical Work** as shown in figure 4.16.

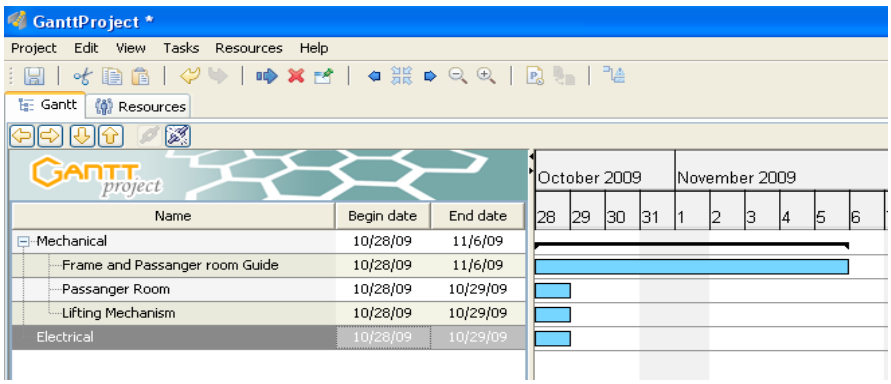


Figure 4.16: Tasks and subtasks

11. Click anywhere in an empty area of the Tasks pane, then click on the **New Task** button. Specify a name of ***Developing the Flowchart***, press **ENTER** and then click the Indent button. Notice that this task displays as a subtask of **Electrical Work**.
12. With the ***Developing the Flowchart*** task still selected, click the **New Task** button and specify a name of ***Writing the Program***. Notice that the task automatically displays as a subtask of **Electrical Work** as shown in figure 4.17.

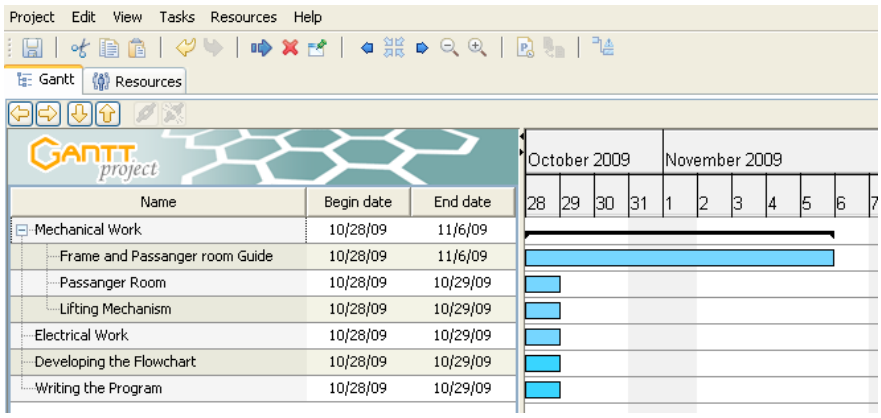


Figure 4.17: The subtasks under the Electrical Work main task.

13. Add the subtasks and durations specified in *Table 4.2* to the ***Frame and passenger room*** sub-task of the project schedule.

Table 4.2: Subtask title and duration

Sub-level Task	**Duration**
Marking	3 days
Sawing	7 days
Drilling	7 days
Riveting	4 days

14. Review the data you entered in the application

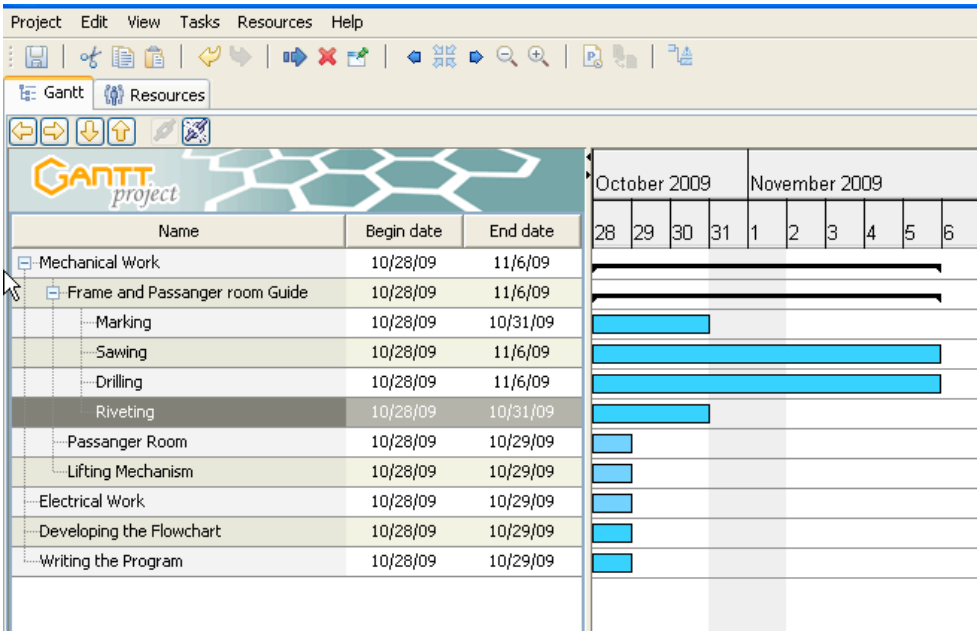


Figure 4.18: Subtasks

15. Next, you will specify task dependencies. In the Gantt chart, click and hold the Gantt bar for ***Marking*** drag it to the Gantt bar for ***Sawing***, then release the mouse button as shown in figure 4.19. This step specifies that the start of the second subtask is dependent on the completion of the first, and moves the start date of the second subtask forward three days.

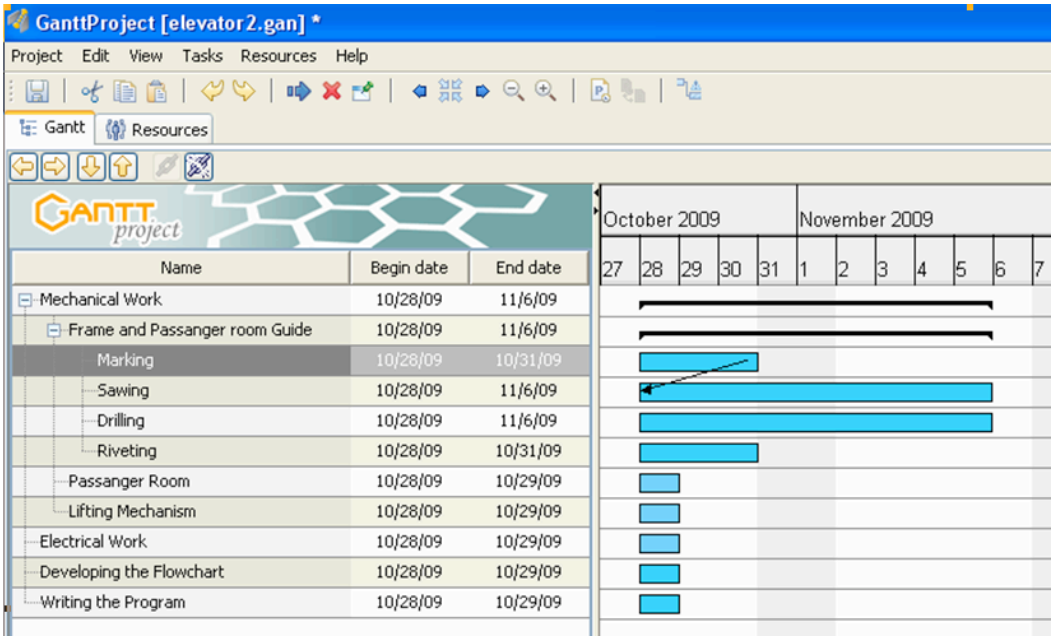


Figure 4.19: Task dependencies.

16. Click and hold the Gantt bar for ***sawing***, drag it to the Gantt bar for ***drilling***, and then release the mouse button. This step specifies that the start of the third subtask is dependent on the completion of the second, and moves the start date of the third subtask as illustrated in figure 4.20.

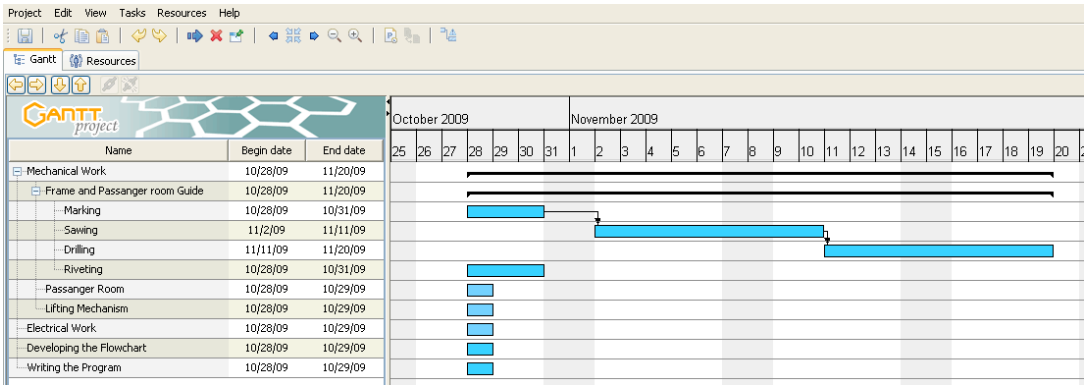


Figure 4.20: A sample of tasks dependencies.

17. Continue to link the remaining Gantt bars so that the start of each task (or subtask) is dependent upon the completion of the previous task (or subtask).

18. Finally, you will specify a new project start date. In the Tasks pane, select the top level task ***Mechanical*** and display the **Properties** dialog box.

19. In the Date section, click the **Show Calendar** button next to the Begin Date box, click the first Monday following the current week, then click **OK**. Notice that the entire project moves forward to reflect the new project start date. Notice also that weekend dates in the project timeline are automatically bypassed as shown in figure 4.21.

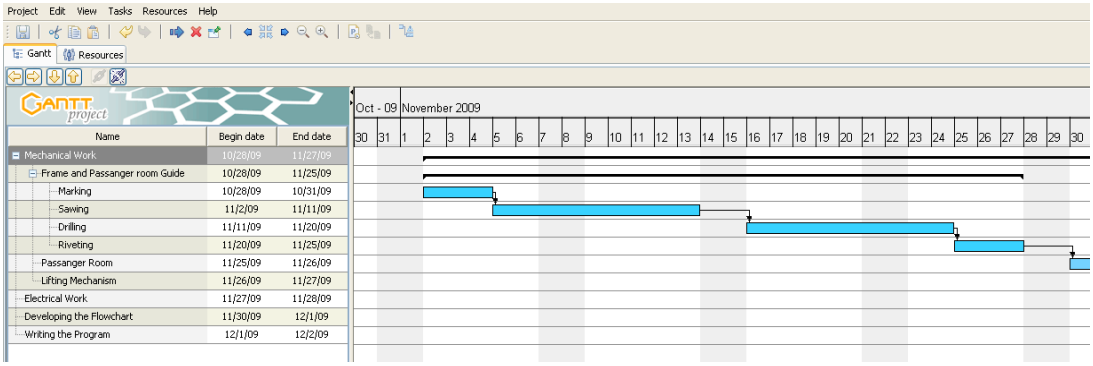


Figure 4.21: The project's new start date.

20. In the toolbar, click the **Next** button several times if necessary to shift the entire Gantt chart into view.
21. In the toolbar, click the Zoom out button to view the tasks in weeks as shown in figure 4.22.

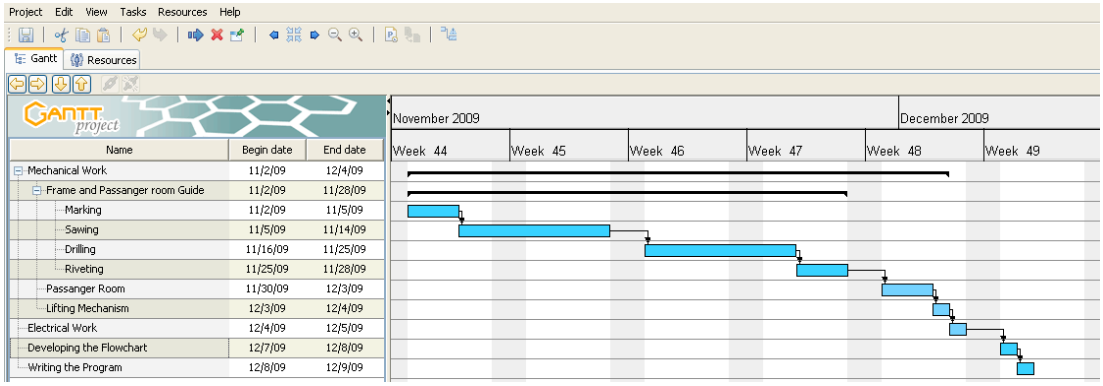


Figure 4.22: View of all tasks in weeks.

22. In order to assign a Task Lead for every Task, right click on the task pane, and then choose **New Custom Column** as illustrated by figure 4.23.

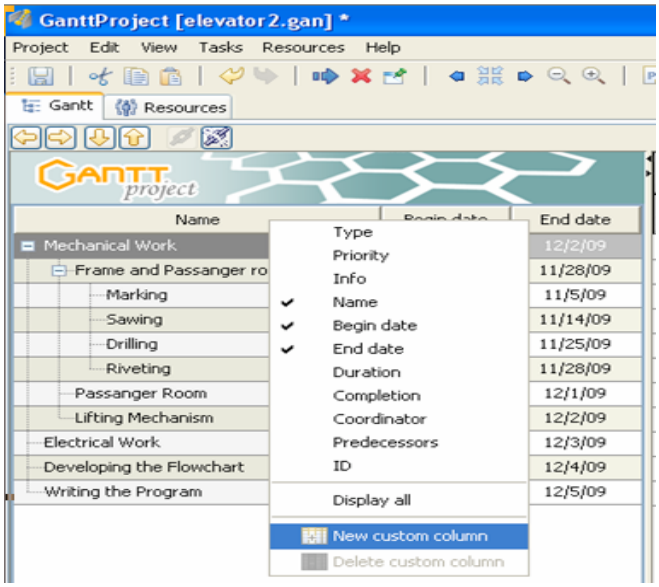
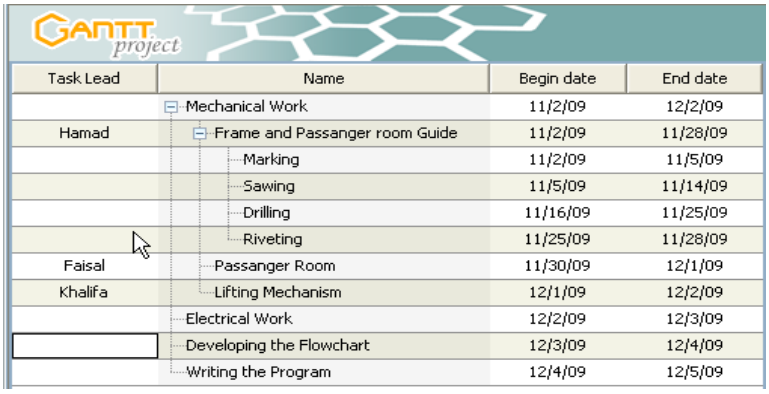


Figure 4.23: Creating a New Custom Column.

23. In the **Column name** dialog box type the name **Task Lead** and choose the column type **Text.**
24. Now assign each Task (activity) to the **Task Lead** as shown in figure 4.24.



Task Lead	Name	Begin date	End date
	Mechanical Work	11/2/09	12/2/09
Hamad	Frame and Passanger room Guide	11/2/09	11/28/09
	Marking	11/2/09	11/5/09
	Sawing	11/5/09	11/14/09
	Drilling	11/16/09	11/25/09
	Riveting	11/25/09	11/28/09
Faisal	Passanger Room	11/30/09	12/1/09
Khalifa	Lifting Mechanism	12/1/09	12/2/09
	Electrical Work	12/2/09	12/3/09
	Developing the Flowchart	12/3/09	12/4/09
	Writing the Program	12/4/09	12/5/09

Figure 4.24: The Task lead column.

25. The same procedures are to be followed to create a column for **Task code**.
26. Exit **GanttProject** and save the project schedule.

4.3 Project Topics

Choose any one of the problems outlined below, and design and build a control system that will provide a solution to the problem described.. Each team shall consist of not more than four students, and the size of the prototype shall not exceed 50 cm X 50 cm X 50 cm.

1. A traffic light uses a series of three lights to control the flow of vehicles through an intersection. When the green light is ON, traffic should flow. When the red light is ON, traffic should stop. The yellow light represents a wait period for all vehicles to clear the intersection. Only one light is ON at a time, but the duration of illumination is determined in a preprogrammed sequence. In a basic open-loop system, the traffic light timing sequence would continuously repeat. However, some intersections, especially those where traffic on the side street is significantly lighter than on the main street, contain sensors to detect the presence of a vehicle before initiating the timing sequence. Design and build a traffic light system that uses the Vernier analog sensor to detect the presence of a vehicle. Use LabVIEW program to make the LEDs go through the standard traffic light pattern.

2. Peter wants to use an electronic birthday candle for his friend's birthday as he plans to give his friend a surprise party at a hill station which is quite windy. Build an electronic birthday candle which uses a red LED as an indicator of wind speed and will act as candle flame.

3. While an EKG sensor is normally used to record muscle activity of the heart, it can also detect other electrical changes in your body, even motion of your eyes. Build a device that switches a bipolar LED from

one color to another when you look left or right.

4. Mark wants to make a ping-pong ball levitate or hover smoothly at a desired height within a tube using the force of air. Build a PID Ping-Pong Ball Levitating System that uses labVIEW program to allow the user to control the speed of the fan from the front panel.

5. Partially blind and shortsighted people sometimes find it difficult to read the measurement displayed on a kitchen scale. Design a kitchen scale that could be used by someone with poor eyesight.

6. In order to conserve energy in an office, the lights and fan should only be ON when the office is occupied, and OFF when the office is empty. Design a control system that uses the Vernier Motion Detector sensor to detect the presence of people in a room and switch on the light and the fan. If no motion is detected after a delay of 2 minutes, the light and fan should be switched off.

7. Design a car park barrier control system to meet the following specifications:
    - The car park has a maximum capacity of 200 cars
    - The system must keep track of the total number of cars in the car park (cars in – cars out).
    - The entrance barrier allows cars in only if the maximum capacity has not been reached.
    - The exit barriers must always allow cars to exit the car park.

4.4 Project Plan Report Template

Project title: .....

Student Names:

1. .....

2. .....

3. .....

4. .....

IAT Campus: .....

Section: .....

Teacher: .....

Problem Description:

Produce approximately one paragraph to describe the problem you need to solve.

_____

_____

_____

Project Investigation:

Carry out relevant research from at least two named sources.

a. What kind of people will use it?

_____

b. Where and when will they use it?

_____

_____

c. What features will be useful for them?

_____

_____

d. What are the existing product features?

_____

_____

e. How are other users using it?

_____

_____

f. What are the existing resources that could be used?

_____

_____

g. How much will it cost?

_____

_____

Proposed Solutions:

Describe atleast two solutions that you propose.

Solution 1: Describe it.

Advantages- describe them.

Disadvantages- describe them.

Solution 2: Describe it.

Advantages- describe them.

Disadvantages- describe them.

Chosen Solution: Justify the choice of solution from the others considered. I have chosen solution X because ……..

Design Specification:

Size, Weight and Appearance

_____

_____

_____

Material list

Safety

_____

_____

_____

Planning & Construction

Analysis:

a. What is the project challenge?

_____

_____

_____

b. Will the system control a sequence of operations? What are they?

_____

_____

c. Is it a closed loop system?

_____

_____

d. What inputs are required?

_____

_____

e. What outputs are required?

_____

_____

f. What type of control does the system need?

_____

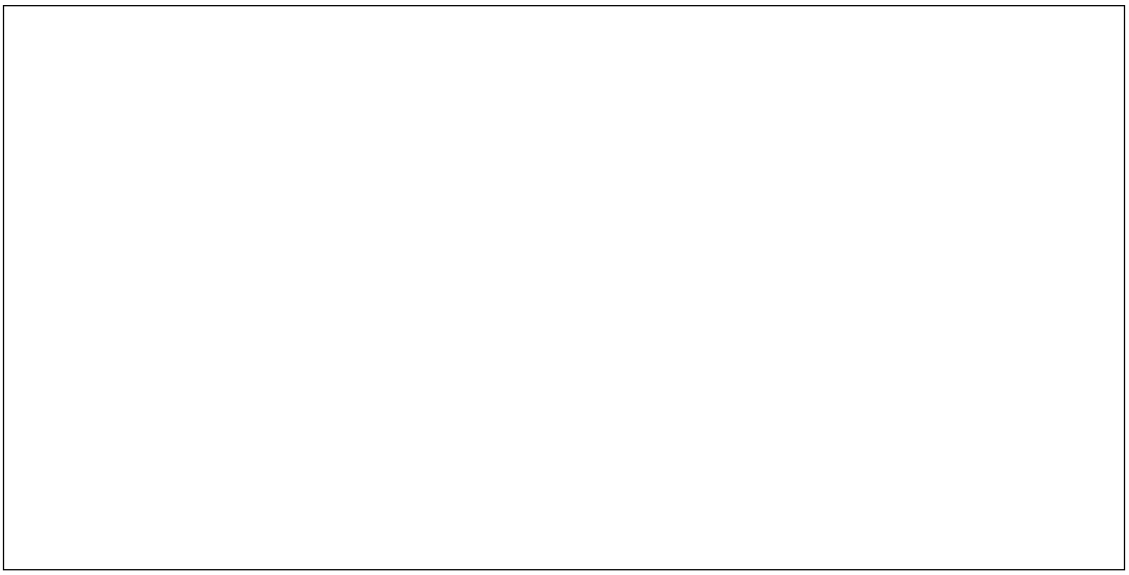
_____

g. Are there any other special considerations?

_____

_____

Sketching *(Imagine, and draw a rough sketch of the prototype in the box provided below)*



System Diagram

Circuit Diagram

Orthographic Drawing

Program (if applicable)

Production Flowchart

Gannt Chart

Project Plan Scoring Guide

A. Assignment Completion: 5 Marks

Component	Score
Report Completion	3
Timely submission	2

B. Report: 45 marks
Content:40 marks; Language & Organisation:5 marks

Criteria	Poor	Satisfactory	Good	Excellent
Problem Description	1	2	3	5
Research/ Investigation	1	2	3	5
Proposed Solution	1	2	3	5
Design Specification	1	3	5	10
Planning & Construction	1	3	5	10
Production Flowchart	1	2	3	5

Total Score: 50 marks