1. Objectives:

IPRO 332's objectives have not changed since the formulation of the Project Plan. The IPRO begins an investigation of the use of mechanical shaker beds in a life-support capacity for beings with cardiac arrest. It will develop and continue research that was begun at the Miami Heart Research Institute, and will work in conjunction with researchers at IIT and the University of Chicago. There are two primary objectives for the semester:

1) Design and construct a controllable shaker bed for mice, based on specifications from IIT and University of Chicago researchers.
2) Investigate the implementation of shaker bed technology as a medical device for humans, including but not limited to: practical, ethical, and legal feasibility.

2. Results to Date

The two subteams have thus far accomplished the following tasks:

Mouse Team

a. Networked with Harshbir Sidhu, IIT graduate student, to discuss the specifications of the mouse shaker bed, particularly the optimum frequency, 13 Hz, and amplitude, 1.25 cm, of the oscillation based on his calculations, as well as the desired range for these parameters, approximately 10-20 Hz and 0.5-2 cm. (September 29)
b. Created a preliminary design of the device, including deciding on the mechanism to shake the platform, devising a method to continuously adjust the frequency and amplitude of the shaking in real time. A device called a zero-max speed reducer, modified slightly, will be used to accomplish this. Calculations for the requirements of the motor and zero-max have been completed. (October 18)
c. The motor, gearbox, and rheostat (for measuring the output of the motor) have been selected. (October 16)

Human Team

a. Networked with Harshbir Sidhu, IIT graduate student, to discuss the specifications, particularly the optimum frequency and amplitude of the oscillation based on his calculations. (September 29)
b. Researched laws and government regulations regarding new medical technology. Relevant points have been documented and summarized. (October 1)
c. Investigated laws, regulations, and procedures specifically regarding the testing of medical technology to be used on humans. The findings have been documented, indexed, and summarized for future reference. (October 1)
d. Began to design a stretcher—shaker assembly for use with humans by paramedics. This includes hand sketches and a simple mechanical model. (October 18)

Additional tasks that have been worked on that were not in the Project Plan include:

a. Discussion of what the purpose of this machine as applied to humans is. It potentially replaces CPR by being more effective, longer duration, and less physically damaging to the subject. Discussions are still ongoing.
b. Began work on a computer model/simulation of the shaking device. This will help decide which zero-max to order.

Overall the results are consistent with the objectives that IPRO 332 has set for this semester, although ordering the parts to assemble the prototype has not yet been accomplished. Much headway has been made on the design of the device, both the mouse shaker and the human design. In turn these will help IPRO 332 reach its overall goals of developing the shaking table for murine experiments at the University of Chicago, and investigating potential uses of such technology with human patients, although much work must yet be done.

3. Revised Task/Event Schedule
The major tasks and milestones of the project, what they entail, and their expected due dates as of 10/20 are listed in the following chart. No major changes have been made, besides removing the tenuous "Sponsor Search" from the list of objectives and updating the due dates to reflect current delays. A prototype can still be constructed, but parts must be ordered as soon as possible for this to happen.

Mouse Team				
Task	**Entails**	**Expected Hours (Personnel)**	**Skills Required**	**Due Date**
Get specifications	Speaking with Harshbir Sidhu, getting his papers and calculations	5 (1)	Mathematics	Done
Preliminary Design	Performing engineering calculations, generating simple schematics of the device, estimating the budget	15 (4)	Mathematics, Dynamics, Electrical Engineering, CAD/Modeling Software	Done
Finalize Design	Verifying calculations, generating schematic drawings, getting design approved by advisor and	20 (All)	Mathematics, Dynamics, Electrical Engineering, CAD/Modeling Software	October 23

	researchers, submitting parts and purchase orders			
Model of Design	Creating a maneuverable, adjustable model of the designed device, both in a computer program and with an Erector Set	5 (2)	Mathematics, Dynamics, Modeling Software, Construction	October 23
Construction	Building a prototype of the device	25 (4)	Machining, Construction, General Engineering	November 15
Troubleshooting	Testing and modifying the prototype as necessary	As Needed, (All)	Machining, Construction, General Engineering	November 22
Human Team				
Calculations and Scaling	Speaking with Harshbir Sidhu, getting his papers and calculations, using them to calculate the proper scaling of a device for human use	10 (1)	Mathematics	Done
Researching Legal Issues and Procedures	Searching online and in libraries for resources on building, patenting, and testing new medical technology	30(2)	Researching	Done
Structure Design	Design a device based on the mouse shaker bed model that will work on human-sized	25 (4)	Mathematics, Dynamics, Electrical Engineering, CAD/Modeling Software	November 1

	subjects			
Research Market	Speak to paramedics and other personnel to ascertain the approximate level of interest in a device such as this for practical use	As Needed (All)	Researching, People Skills	November 22
IPRO Deliverables				**Responsible Party**
Project Plan	Create a project plan in accordance with IPRO guidelines	15	Done	Team Secretary
Midterm Report	Create a midterm report in accordance with IPRO guidelines	15	October 20	Team Secretary
Exhibit/Poster	Create the booth display for IPRO Day	5	November 22	All
Project Abstract	Create an abstract of the project for IPRO Day	5	November 22	Team Secretary, Subteams
Website	Create the website, update it as progress is made and milestones are reached, submit it for IPRO review	TBD	November 27	Web Designer
Final Presentation	Create a PowerPoint Show and script for the IPRO Day presentation	10	November 29	All
Final Report	Collect summaries from each team member and combine into the final report of the	20	November 30	Team Secretary, Subteams

	semester			
Team Information	Submit information about the IPRO team members	2	November 30	Team Secretary
Comprehensive CD	Collect all relevant documents and compile them on the CD to be distributed at IPRO Day	1	December 1	Team Secretary

4. Updated Task Assignments and Designation of Roles

No major changes to assignments have taken place, as thus far there has been no obstacle which requires permanent reorganization of personnel, although due to delays some members of the Human Team have helped the Mouse Team with models of the device. Also, specific tasks for each person within each subteam have become more sharply clarified and defined. The bullet points under each person indicate their specific tasks; asterisks denote members of other subteam who have contributed to this subteam's goals.

IPRO 332 consists of the following personnel:

Prof. Francisco Ruiz – MMAE Department – Advisor, Team Leader
- Approval of all designs and purchase orders

Harshbir Sidhu – Mechanical Engineering Graduate Student – Researcher/Aide
- Scaling calculations to define parameters of oscillation for both mice and humans
- Dynamics calculations to define parameters of the zero-max to be selected

Mouse Team:

The Mouse Team will construct and test the mouse shaker bed.

John Burica – Electrical Engineering
- Selection of components, particularly electrical parameters
- Construction and modification of the mouse shaking device

Patrick Folz – Aerospace Engineering – Subteam Leader, Team Secretary
- Dynamics calculations to define parameters of motor and zero-max
- Creation of simple mechanical model of zero-max using Erector Set
- Selection of zero-max
- Construction and modification of the device
- Compiling and submitting IPRO materials

Grant Justice – Mechanical Engineering
- Selection of components, particularly mechanical parameters
- Construction and modification of the mouse shaking device

Maribel Valdez – Aerospace Engineering
- Dynamics calculations to define parameters of motor and zero-max

- Creation of simple mechanical model of zero-max
- Construction and modification of the device

***Hazel Ramirez*

- Creation of computer model of zero-max

***Jakub Krynski, Yun Wei*

- Creation of mechanical model of mouse-shaking device using Erector Set

Human Team:

The Human Team will research and design the human shaker bed.

Jakub Krynski – Electrical Engineering

- Design of electrical system for human device
- Concept for human device (i.e. how it would actually work in practice)
- Schematics of human device

Alok Patel – Biomedical Engineering – Subteam Leader

- Scaling calculations to define parameters of oscillation for humans
- Concept for human device
- Schematics of human device

Hazel Ramirez – Biomedical Engineering

- Research about legalities and procedures for creating new medical technology
- Concept for human device

Yun Wei – Electrical Engineering – Web Master

- Website creation and maintenance
- Concept for human device

5. Obstacles

The only obstacles encountered so far have been on the part of the Mouse Team. The major obstacle encountered thus far has been difficulty performing the calculations to define the necessary parameters of the motor and zero-max speed reducer. Because the device is significantly more complex than those analyzed in class before, the kinematic and kinetic equations have taken much time to formulate and solve. For the motor, Patrick and Maribel performed independent calculations, one focusing on the kinematic definition and one focusing on the kinetic definition of the device. The results did not agree to an acceptable degree, so in selecting a motor a Factor of Safety was used that accommodated both results. Based on Prof. Ruiz's mechanical intuition, a motor of such power should certainly be sufficient for the task.

For the zero-max, Patrick, Maribel, and Harshbir each performed separate calculations using somewhat different assumptions. Patrick's and Maribel's simplified models produced similar results, so these have been used in preliminary searches. Harshbir has just completed a more complex analysis of the zero-max and is using his results to make Hazel's computer model as accurate as possible. If his results reasonably agree with the earlier ones, the team can be confident in selecting the correct zero-max device.

The other obstacle encountered was in locating a motor that both performed at the calculated necessary output and was small enough for laboratory use. Eventually such

a motor, and its attendant components, was located by John and Grant, but the search took longer than expected.

The next obstacles that the team anticipates include the delivery time for the components and the modification of the zero-max to perform as desired. Due to delays, if the parts do not arrive soon a working prototype will not be able to be built. To solve this some of the budget will be used to get the fastest shipping possible. More critical is the zero-max modification, since the zero-max speed reducer is typically used for reducing motor speed, whereas in this application it will be used for adjusting the amplitude of the oscillation. The device functions in fundamentally the same way, although most zero-max reducers come in a metal casing with an output axle. These will have to be removed and the inner workings of the device rearranged in such a way that the zero-max can be attached to a platform to shake the mice.

The Human Team anticipates no large obstacles save delays due to some team members being pressed into service with the Mouse Team to rectify their delays.