

# FLYCYCLE PROJECT PROPOSAL



**University of Maryland**

**Team:** MRE (Medical Robotics and Equipment) Lab

**Team Lead:** Assistant Professor Dr. Axel Krieger

**Graduate Student:** Anirudh Topiwala

## 1) Goal and Objectives

We propose to setup and modify the Flycycle robot, donated by ATR Corporation to the Maryland Robotics Center. This robot is a Virtual Reality (VR) exercise machine that provides a complete as well as an entertaining workout for the upper and the lower body. The idea here is to combine the lower body workout of riding a cycle with the upper body workout of hand gliding. Using the feedback from the sensors, the user is completely immersed into the VR game which is controlled by his body movements. The full exercise entails activities like climbing, diving, banking and pedaling.

The **short-term objective** this summer is to modernize and improve the Flycycle so that it can be used with state-of-the-art immersive VR technology and interactive games. The **long-term goal** for the Flycycle is to utilize the system for rehabilitation of patients, such as patients with muscle dystrophy. Another area of improvement would be to convert all the degrees of freedom (dof) to actuated dof. This will enable the Flycycle to be used in active feedback applications for example to experience flight and falls. Part of the long-term plans include setting up educational programs and student lead parallel competitions for example in game creation and mechatronic simulation and actuation.

### (a) Modernizing the Flycycle

The first set of objectives would be to modernize the Flycycle. This would include validating the integrity of the existing sensors and if necessary replace any damaged parts. Secondly, a study will be carried out on what parts can be modernized to make the robot compliant with the state-of-the-art VR technology and recently developed games and software's as the robot was designed a long time back. An example here would be changing the operating system on board. Finally, the Flycycle will be fully integrated with an Android or an IOS game to give an immersed Virtual Reality Fitness gaming experience.

### (b) Improvements on the Flycycle

Once the robot is up and running, further improvements on the robot will be carried out, such as extending the gaming experience to a fully immersive VR headset as opposed to interacting with an LCD display. Another area of improvement is exploring the use of the Flycycle for rehabilitation purposes, such as for pediatric patients with muscle dystrophy. This will be possible by exploring the potential of fully actuated degrees of freedom.

**To summarize, the project consists of the following Five objectives:**

- 1) Assembling the Robot when it arrives at Robotics Realization Lab and Experimenting with the actuations of the robot to get a better design perspective.**
- 2) Identifying and ordering replacements to Modernize the Robot and its interface.**
- 3) Integrating a Desktop game with the Flycycle sensors to get an entertaining Fitness experience.**
- 4) Making the Flycycle VR compatible. This includes developing a VR interface using headsets such as Oculus Rift to get a completely immersive experience of the game while working out the body.**
- 5) Explore areas for the use of Flycycle Robot for rehabilitation Purposes such as for pediatric patients with muscle dystrophy.**

**At the end of this summer project, we will execute all the above objectives to build a first of its kind Flycycle used for exercising with a Virtual Reality experience.**

## 2) Project Plan and Milestones

For this project, we will be using the Flycycle robot donated by the ATR corporation to the Maryland Robotics Center. The project is divided and executed into five objectives. 1) Assembling the Robot when it arrives at Robotics Realization Lab. 2) Identifying and ordering replacements to Modernize the Robot and its interface. 3) Integrating a Desktop game with the Flycycle sensors to get an entertaining Fitness experience. 4) Developing a VR interface using headsets such as Oculus Rift to get a completely immersive experience of the game. 5) Explore areas for the use of Flycycle Robot for rehabilitation Purposes such as for pediatric patients with muscle dystrophy.

In objective one, with the help of the technical lead from the ATR corporation, we will assemble and set up the Flycycle robot in the Robotics Realization Lab. This will include, making sure that all parts are attached properly and understanding the basic instructions and guidelines on handling the robot. The next part would be to experiment with the limitation of the actuators of the robot and get a better design perspective.

For objective two, a thorough analysis of the existing sensors will be made. Also, a study will be carried out on what parts can be modernized to make the robot compatible with the recently developed state-of-the-art VR games and software's as the robot was designed a long time back. Once this is done, the new sensors and parts will be integrated with the Flycycle and a basic demo of the Flycycle will be carried out. Here, the outputs from different sensors will be studied and checked if the integration was successful.

For objective three, a game will be developed so that the Flycycle can interact with the game and give a visual feedback on the computer screen. This will enable the user to play the game using his own body. The game would be either developed in Android or in IOS. The theme of the games would be on similar grounds as flight simulators or car racing games, so that the acceleration can be controlled by the pedaling speed of the Flycycle and the steering of the vehicle will be controlled by the user's body (using the potentiometers mounted on the top two arms of the Flycycle). The level of effort required can then be used to set different levels in the game. Although, the difficulty level of the game would not be able to be changed significantly because of the passive degrees of freedom. Once the game is operational, we should have a fully functional Flycycle robot set up.

The fourth objective, is to make the Flycycle VR compatible. This will enable the user to get a completely immersive experience of the game. This is in comparisons with the latest developments made in the field of VR Fitness. Companies like ICAROS and Black Box VR have already started working on combining physical fitness with Virtual Reality games to give a fun and immersive workout.

The final objective for the summer is to explore areas in which Flycycle can play a critical role as a rehabilitation robot. As the Flycycle aims at working out the entire body, it can help patients build muscle strength. Also, if we integrate active degrees of freedom into the robot, then we can vary the stress incurred on the muscles and tone the muscle as required. The area targeted would be using the Flycycle for pediatric patients with muscle dystrophy.

The two milestones for the summer project are; 1) Modernize the Flycycle, so that the user is able to interact with a computer game using his body movements. This should be completed by the end of July. 2) Make the Flycycle VR ready and convert the regular fitness sessions into a completely immersive fitness exercise. Also, explore the potential of the Flycycle as a Rehabilitation Robot. This should be completed by the end of summer (month of August).

### 3. Budget for the Summer

Items	Cost
Computer Screen	750
Industrial Grade Joystick Potentiometers	$75 \times 4 = 300$
Oculus Rift with Accessories	1200
Oculus PC	2700
Sensors and Miscellaneous Electronics	4500
Additional Hardware and Replacements	3000
3D Prints	800
Graduate Research Assistant: Anirudh Topiwala (40 hrs./week @\$15/hr.)	7800
Total Cost	20000 \$