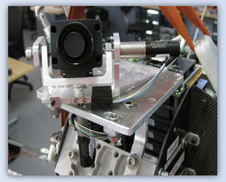
ROBOTIC VISION PLATFORM

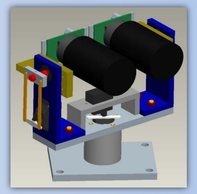
Scott Bevan, Matthew Kandler, Danielle Renzi, William Rittase and Advisor Professor Steven Shooter

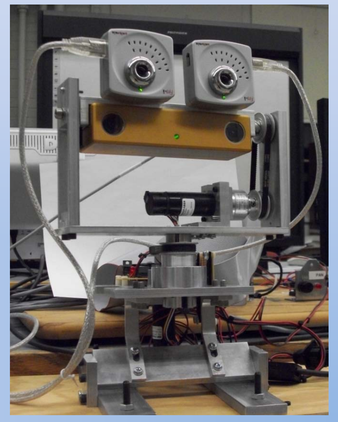
Motivation

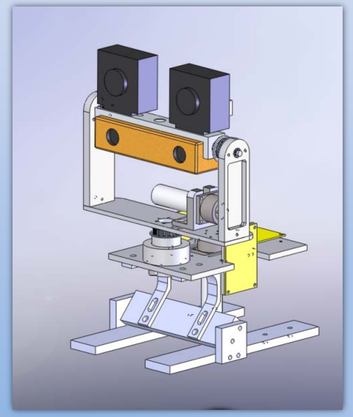
Bucknell University has partnered with The Institute of Human and Machine Cognition to develop a robotic vision platform for a walking bipedal robot. Currently the biped has legs and a torso but no arms or legs. The mission of this project was to provide 3D vision and mapping to the robot with potential capability of object recognition. The current biped is shown to the right.



There were two previous iterations, one was developed at IHMC by Kandler and Snyder , the other was developed by Rittase and Sirot at Bucknell. The Kandler/Snyder design is shown to the left and the Rittase/Sirot is on the right.







Results

The specifications proved to be more challenging than originally expected.

•The RVP exceeds its specified width.
•The head weighs roughly .8 lb more than was intended. This was a result of last minute changes to the motor/gearhead piece and the base, and incorporation of electronics.
•The specified speed was not achieved, but the acceleration was much higher than specified. It appeared, however, that the RVP could attain higher speeds if it had more time to reach them. Also, 95 rpm appeared to be sufficiently fast and if it were to go faster, it would likely cause the operator discomfort.

Specifications	Value	Tested Value w/o Shell
Size	smaller than 8”x8”x 10” (DxWxH)	7”x9”x8.5”
Weight	4 pounds	4.82 lb
DOF	2	2
Min. Speed	200 rpm	94.5 rpm
Min. Acceleration	1800 deg/s^2	6916 deg/s^2
Accuracy of Positioning	Less than 1^o	N/A
Resolution of Positioning	.01^o	.004^o
Range of Motion	180^o pan, 150^o tilt	+/-175^{o}pan, sufficient tilt
Number of Cameras	4	4
Camera Frame Rate	30 frames per second	30
Field of Vision	60^o	39.0^o
Resolution	640 x 480	640 x 480

Specifications

The RVP is expected to be mounted onto the current biped robot and have the potential to interact in an urban environment. Keeping this in mind, the design was intended to:

-Zero Backlash
-Minimize weight
-Minimize size
-Be compatible with existing biped software
-Pan and tilt quickly, but not so quickly as to cause discomfort to operator

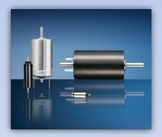
Thanks to Jerry Pratt, Peter Neuhaus, John Carff, Dan Johnson, Jason Geist, Brent Noll, and Matt Tanner, for their help with this project throughout the year. Special Thanks to Jeff Gum for his help with all the electrical equipment.

Components

Motors and Gearheads

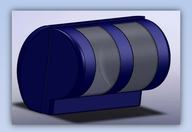
A harmonic gearhead was chosen because it is extremely accurate, up to about 1/30th of a degree (shown bottom right). The gearhead had a gear ratio of 50:1 to achieve the appropriate torque.

This was coupled with a brushed DC motor from MicroMo (shown at right).

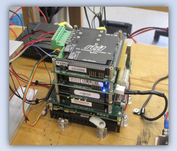


Shell

A carbon fiber Kevlar shell was manufactured. The shell is attached to the pan bracket and moves with the pan axis of rotation but not the tilt.



Computing Power



Currently on the biped robot a PC\104 is used to power and control the robot. In order to keep consistent with the current biped, a PC\104 is used to power and control the RVP. This computer is shown to the left.

3D Goggles

3D vision was important to the team. 3D Goggles from eMagin were used in tandem with the Fire-I cameras to achieve this effect. A picture of the goggles is shown at left.

Cameras

Three types of cameras were explored during the course of the project.

•Point Grey’s Bumblebee2, a binocular camera system for 3D mapping.

•Point Grey’s Firefly MV

•Unibrain’s Fire-I was purchased upon realizing issues with the Firefly MV image signals.

Future Work

In the future, it would be ideal to attain the specified values determined in the beginning of the semester. A number of recommendations can be made for the future.

•Size and weight of the RVP need to be decrease by adding pockets to some parts and decreasing size.

•More research should be done in order to select appropriate cameras in future iterations

•The addition of sound – both a microphone and a speaker for communication

•The Bumblebee2 could also be utilized for object tracking and mapping