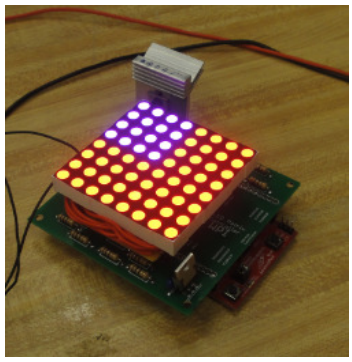
Camera/FPGA system

Electrical & Computer Engineering Department

Robot Localization for FIRST Robotics



Tracking Beacon

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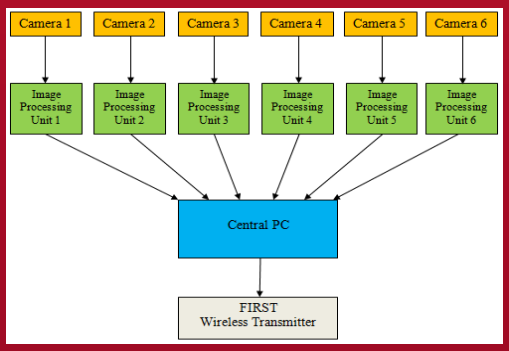
2nd Place Provost MQP Award

Overview

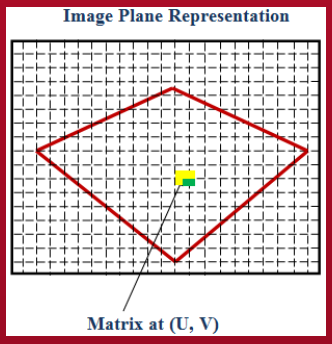
In order to enhance the FIRST Robotics Competition experience, our system determines the (x, y) coordinates of competing robots in real time and sends the coordinates to the robots. Robots have unique LED beacon patterns attached to them, and cameras capture images of the arena during operation. Information from the cameras moves along a pipelined data path, over which it is interpreted. A central PC combines the information from all cameras to calculate the precise coordinates .

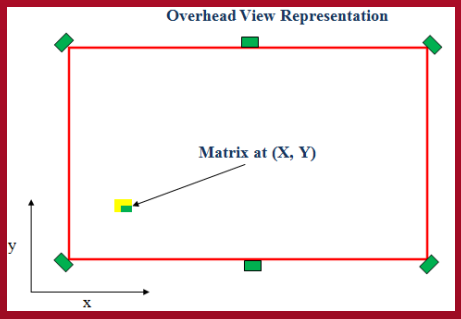


System Hierarchy

Calibration/Beacon Reconstruction

The central PC receives the locations of calibration markers and tracking beacons within each image. When calibration marker locations are received, the central PC uses their locations to automatically determine the exact pose of the camera. This process allows simple setup by FIRST organizers before a competition begins. When the camera is calibrated, the central PC uses tracking beacon locations from each camera to reconstruct the location of each robot.





Tracking Beacon

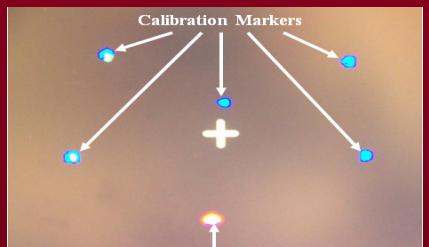
The custom designed LED beacon uses an MSP430 microcontroller in order to control what pattern is displayed. This component included a TI Launchpad, custom PCB, and an LED matrix.

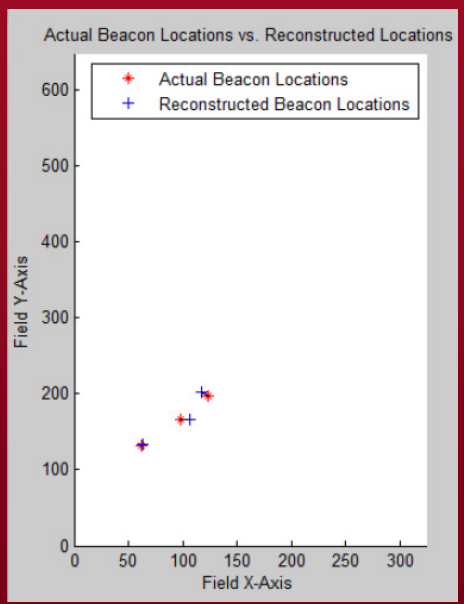
Image Processing

Processing includes conversion of image data to RGB format, color filtering, and pattern recognition to identify calibration markers and beacons within the images. This is done to significantly decrease the bandwidth required to send image data to the central PC. The pixel coordinates and unique ID for each beacon are all that are

Results

Our system was able to reconstruct locations of robots with a maximum error of 8 inches. This system would be useful in a FIRST Robotics Competition.





Scaled FIRST competition