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# Remote Viewing Robot

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# Robots at Fermilab

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- We don't have very many.
- Many other labs are very advanced at this point.
- You have to crawl before you walk. You have to walk before you run, etc etc.
- We have barely crawled.
- We need to start with a realistic, achievable goal that is also actually useful to us.

# Remote Viewing

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- We get dose from inspecting things in the tunnel and monitoring critical jobs.
- Last summer we had to fix the motion control on several collimators at MI-30. Engineers, physicists, managers, etc. that wanted to see progress walked up to the collimators to inspect them, and got dose in the process.
- It would be nice if people didn't have to be physically near radioactive stuff to see it in detail...

# MARV

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- Ray Tomlin developed the MARV robots about 15 years ago. They used them in the Booster to conduct visual inspections and radiation surveys while the machine was on.
- MARV = Mobile Arm Radiation-measuring Vehicle
- They were operated via Wi-Fi (which the Booster has) using a website interface. They were glitchy.
- The electronics hardware is now out-of-date and hard to service. The website to run them no longer exists, and the code wouldn't work because our internet security protocols at Fermilab have changed in the past 15 years.
- Ray gave me MARV 2 and MARV 3.

# Remote Viewing Robot

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- Let's use MARV 2 as the basis to build our own remote viewing robot.
- We don't need to design the remote viewing part ourselves. The hobby drone community has already done that for us. We can use a stereo camera and FPV drone goggles to provide a very detailed 3D image to the robot operator.
- We can strip the MARV 2 robot down to the bare chassis and then design and build our own articulating camera mount that can be controlled remotely.
- Cheap and simple is the key here. We should try to use Arduino for the electronics, as it's customizable and cheap. We should use 3D printing for many mechanical parts for the same reasons.

# Initial Goals

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- Drive 300 feet away.
- Remotely inspect something with good enough clarity that it substitutes for actually being there. The camera should be able to move up, down, forward, backwards, left, and right, but also be able to pan and tilt. The controls should be fluid and intuitive.
- Drive back.
- Look cool. If you're going to build a robot you might as well make it look cool.
- Get all of this done in time for the collimator job at the end of the shutdown.

# Checklist

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- Strip the MARV 2 robot down to the chassis. Get it to drive around using wired or radio control. We probably want to use an Arduino to control everything starting with this step.
- Research and purchase a good FPV drone stereo camera setup and learn how to use it.
- Design and build a robotic arm to hold the stereo camera.
- Mount the robotic arm on the robot.
- Thoroughly test the finished robot to find problems and fix them. This will be useless if it fails us at a critical time.

## Extra Features

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- After the initial goals are complete we can add more features.
- Be able to snap pictures/video from the camera and save it.
- Be able to display the live camera image/video on a screen as well as on the FPV goggles.
- Be able to zoom with the camera.
- Add a quality microphone and speaker to the robot and controller so that the robot operator can communicate with people near the robot.
- Add sensors and tools to the robot so that it can do more than just visual inspection.
- Whatever else we think up.