

EPICS Maintenance Tools and Practices At FRIB's Diagnostics Department

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Introduction

The FRIB's diagnostics group under the Beam Instrumentation and Measurements department is responsible for a variety of instruments and devices used to measure beam parameters that are essential for the machine overall tuning and operation. The team manages 15 device types with about 350 total device instances. In the controls layer, there are 36 Experimental Physics and Industrial Control System (EPICS) Input/Output Controllers (IOC) types with about 250 instances. Each device has its own set of preventive and corrective actions, requirements and tools.

Corrective Actions and Tools

- EPICS iocStats module is the core of most of the corrective software maintenance tasks.
- HealthIOC was developed to act as a supervisor for all diagnostics IOCs, it finds all diagnostics IOCs by searching channel finder for IOCs that have the owner tag set to "diag". Then, it spawns one monitor for each IOC found. If necessary, it can also perform programmed corrective actions.
- The diagnostics devices have a myriad of configuration parameters that have to be monitored and set before every operation run and a tool was created to help with this task.
- RestoreIOC reads the desired configuration state from a database file and uses pyDevSup with callbacks comparing the desired setpoints with the actual value.
- If divergences are found, they are presented to the user, as shown in Fig. 3. Also, specific groups of setpoints can be individually restored on command.

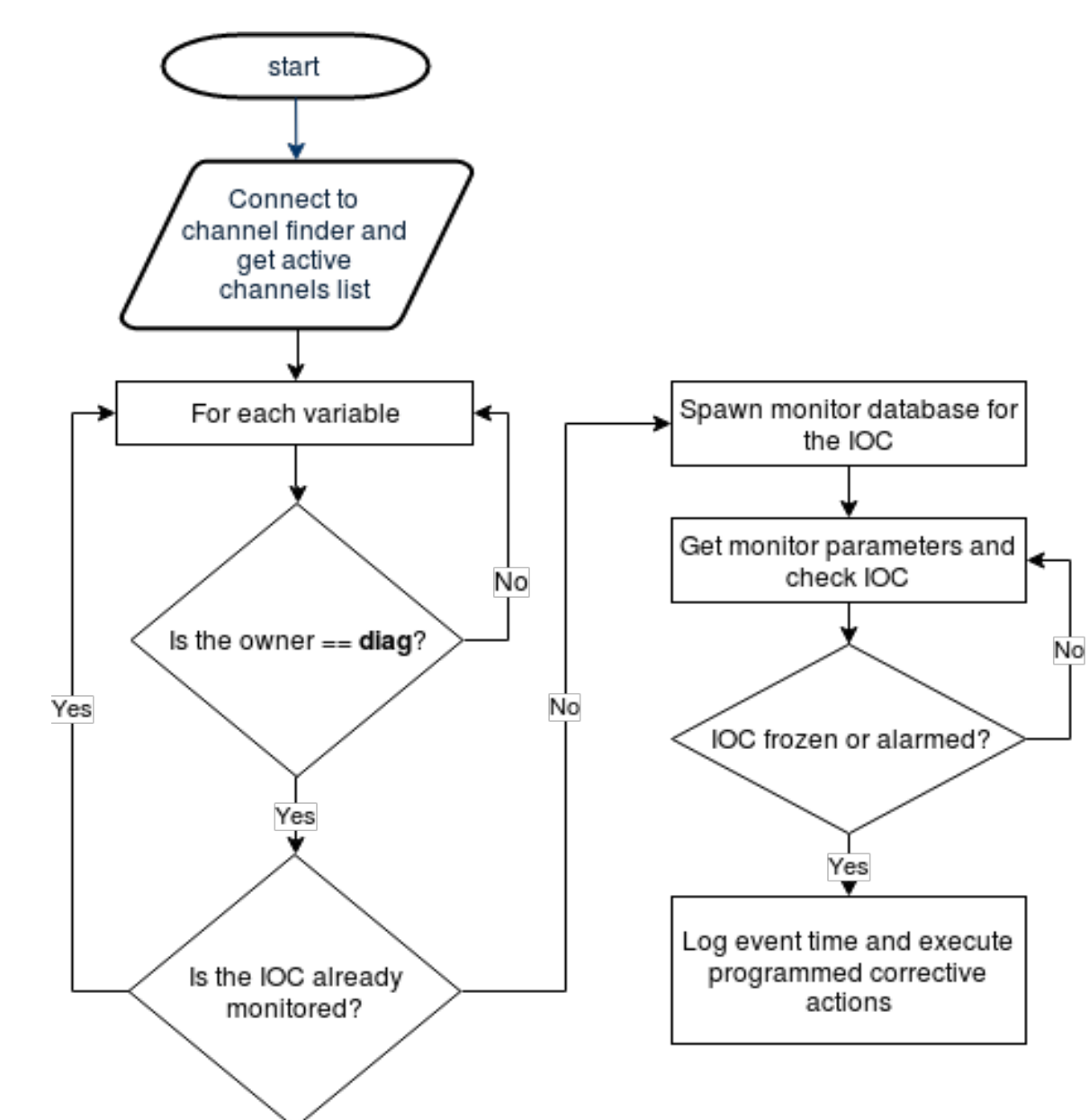


Figure 1: HealthIOC Operation Diagram

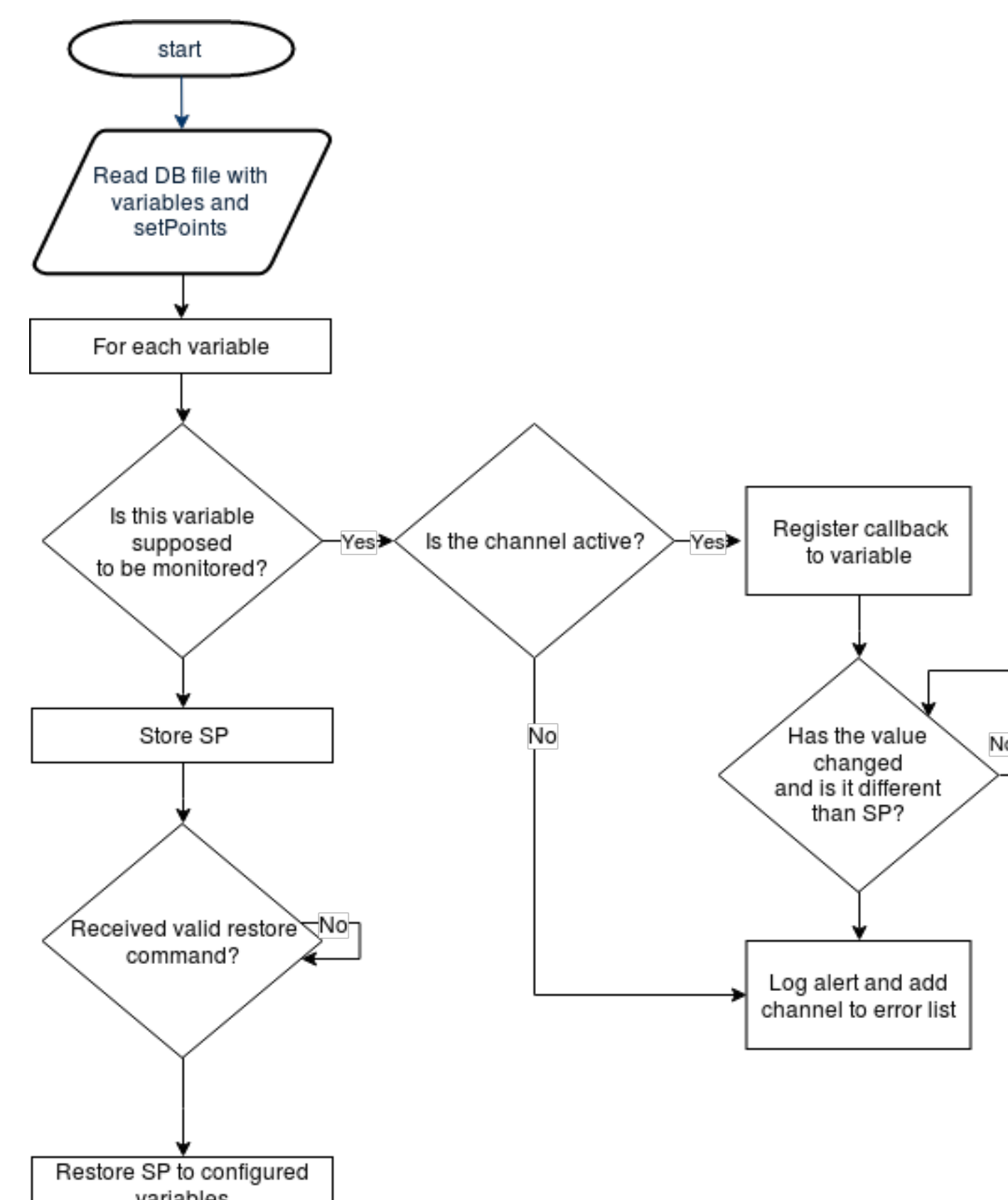


Figure 2: RestoreIOC Operation Diagram

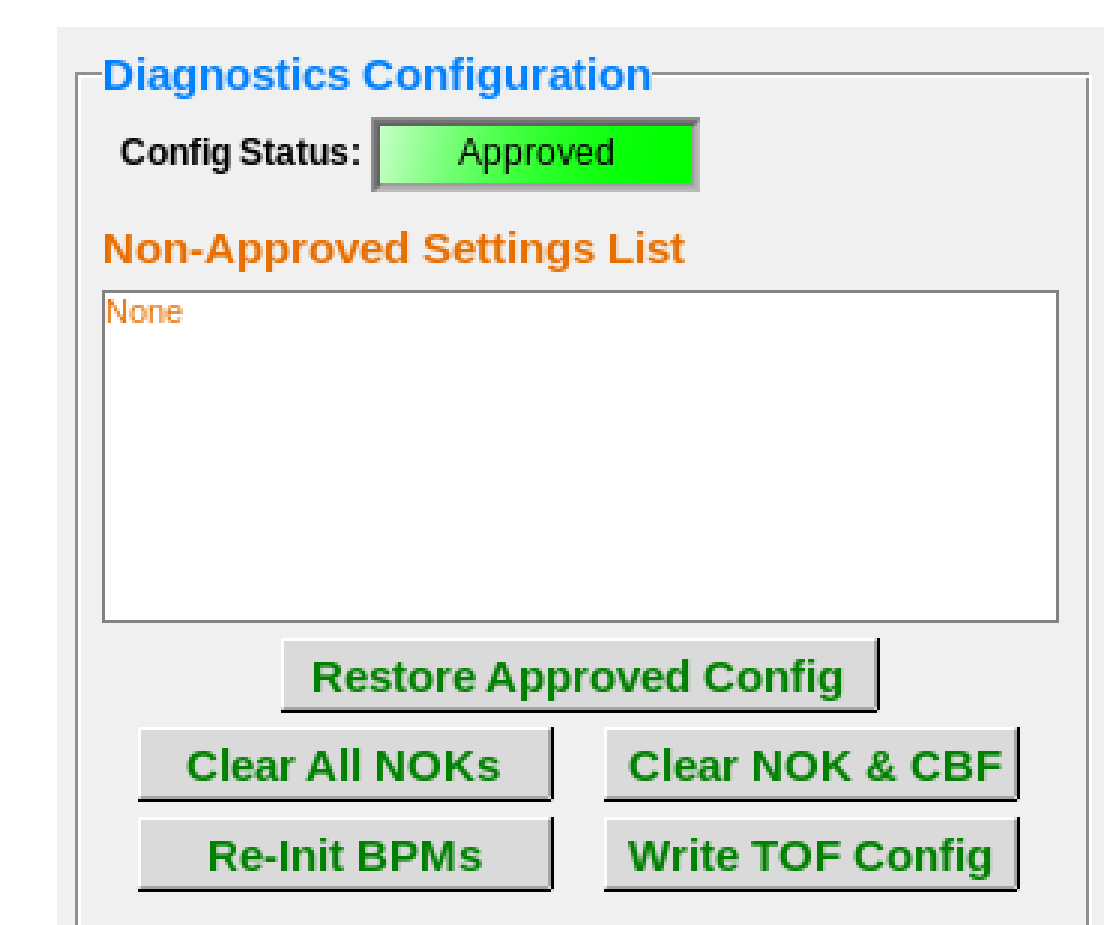


Figure 3: RestoreIOC GUI

Preventive Actions and Tools

- While almost all maintenance activities require some machine downtime, a good preventive maintenance program can decrease and optimize that downtime. With that in mind, the diagnostics group has developed a set of tools to avoid solely relying on reactive maintenance.
- For the non-intercepting devices, automatic electronics calibrations are run overnight or on machine idle time with calibrated test signals, and the results are archived for posterior analysis and action.
- The intercepting devices are monitored during normal operations where all the mechanical missteps and positional drifts are automatically monitored, archived, and alarmed over set thresholds.
- MaintenanceIOC was developed to help estimate the overall health and wear of particular devices and if deemed necessary, trigger preventive maintenance activities on them.

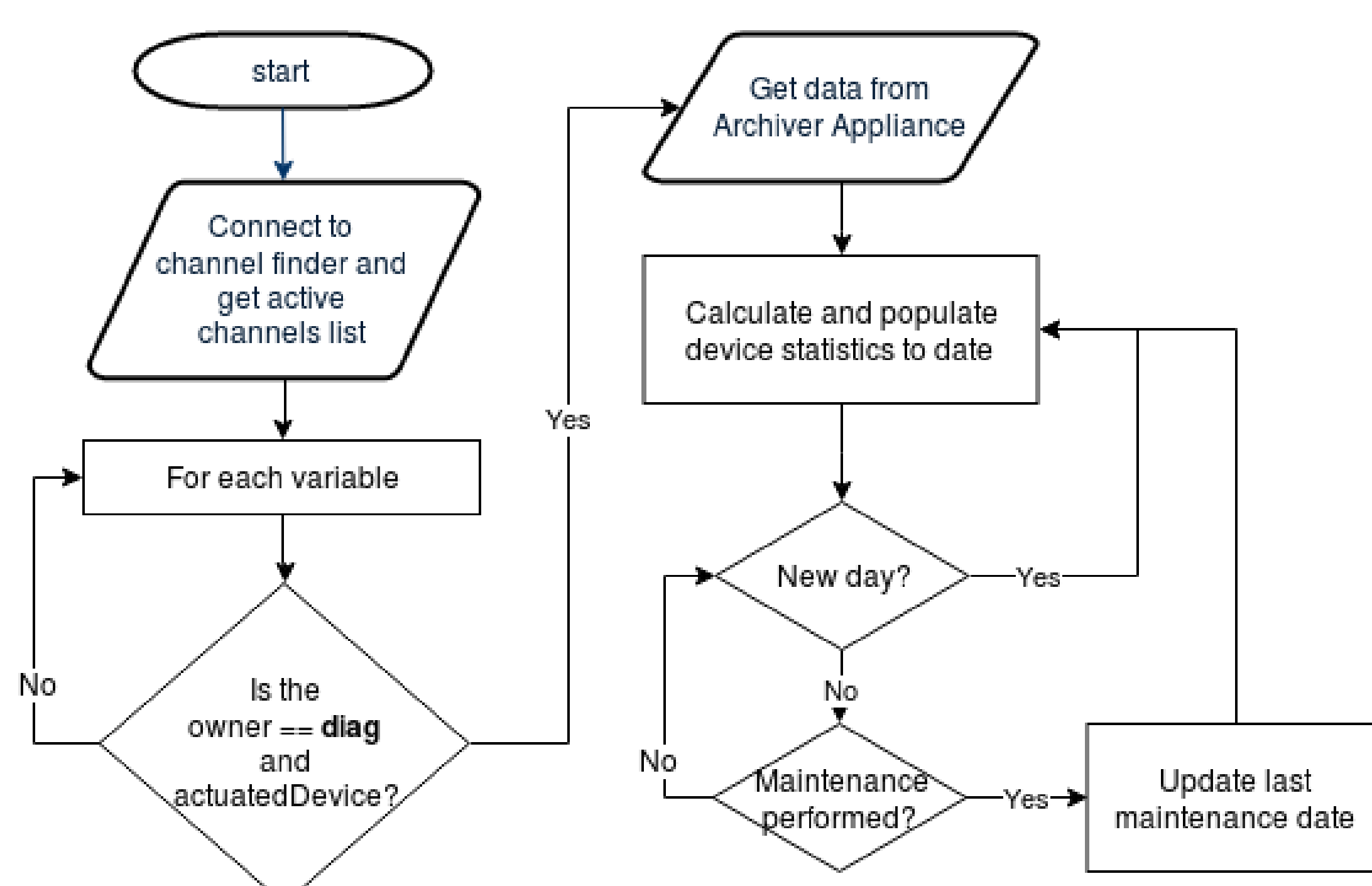


Figure 4: MaintenanceIOC Operation Diagram

Device Maintenance							Update Distances
Motor Devices							
Automatically updated once per day. Distance and uses are since last maintenance date.							
Status	Update complete.						
D0783_PM-L1	Total Distance	234.67372 m	Use Count	807	Last Maintenance	07/25/2018	Reset
D0783_PM-L2	Total Distance	502.95524 m	Use Count	895	Last Maintenance	07/25/2018	Reset
D0808_PM-L1	Total Distance	129.49843 m	Use Count	449	Last Maintenance	07/25/2018	Reset
D0808_PM-L2	Total Distance	248.35038 m	Use Count	464	Last Maintenance	07/25/2018	Reset
D0824_PM-L1	Total Distance	79.08824 m	Use Count	227	Last Maintenance	07/25/2018	Reset
D0824_PM-L2	Total Distance	158.06464 m	Use Count	256	Last Maintenance	07/25/2018	Reset
D0856_PM-FX	Total Distance	227.30732 m	Use Count	581	Last Maintenance	11/02/2017	Reset
D0856_PM-FY	Total Distance	631.23522 m	Use Count	543	Last Maintenance	11/02/2017	Reset
D0884_PM-FX	Total Distance	232.62606 m	Use Count	338	Last Maintenance	11/02/2017	Reset
D0884_PM-FY	Total Distance	1115.03514 m	Use Count	568	Last Maintenance	11/02/2017	Reset
D0912_PM-FX	Total Distance	121.59634 m	Use Count	284	Last Maintenance	11/02/2017	Reset
D0912_PM-FY	Total Distance	227.12895 m	Use Count	276	Last Maintenance	11/02/2017	Reset

Figure 5: MaintenanceIOC User Interface