HINZ
A Rockwell Automation Company

Potash Corporation of Saskatchewan
PCS Lanigan - Miner Automation

The Client:

PotashCorp is an integrated producer of fertilizer, industrial and animal feed products. They are the world's largest fertilizer enterprise by capacity, producing the three primary plant nutrients – potash, nitrogen and phosphate. Among these, potash – the namesake of their company – delivers the highest quality earnings in the fertilizer universe.

With a majority of the world's excess potash capacity, large low-cost operations and strategic global investments, they have an unmatched ability to serve both North American and growing offshore markets.

The Requirement:

The goal of this project is to develop a laser guidance system for a mining machine. This system controls the motion of the mining machine in both horizontal and vertical directions so that the mining machine always follows the desired path pointed by the laser gun which has been pre-installed by the mine surveyor. The key technology is the use of a matrix of photocells or light dependent resistors (LDRs) along with a customized microprocessor.

The microprocessor keeps track of the laser footprint on the matrix from the knowledge of illuminated photocells. It sends analog signals proportional to the offset of the laser footprint from the center of the matrix to the PLC in order to nullify the offset or to pull the mining machine back to the center.

The Design Solution:

A matrix of photocells was considered the best solution for this problem. The array had a number of advantages over other methods such as camera systems. The array was more durable, less prone to vibration, and components were cheaper to replace. Large photocell matrixes were not available on the market however, so one had to be designed from basic components.

Operational requirements

- A source voltage of 24 VDC to power the photocell matrix (sensor) and microprocessors: RabbitFLEX and RabbitNet
- The maximum current drawn by the cell matrix in the worst case scenario not exceeding 320 mA
- Two analog outputs within the range of 0 to 10 VDC from the microprocessor to input into a PLC for controlling the mining machine in both horizontal and vertical directions.
- One digital signal output from the microprocessor to input into a PLC for triggering an alarm or shutting down the mining machine in the event the laser footprint goes off the matrix
- Filtration of unwanted occasional broad bright lights at firmware level

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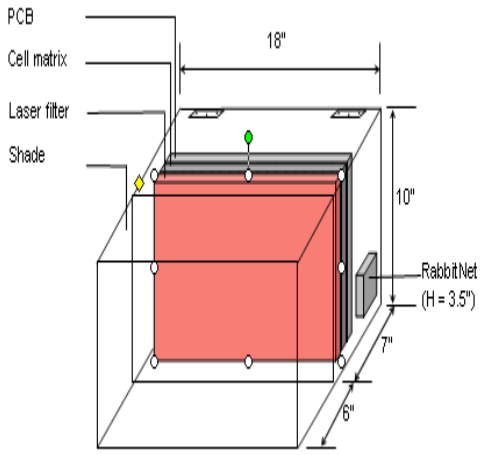

Figure 1. Photocell Matrix

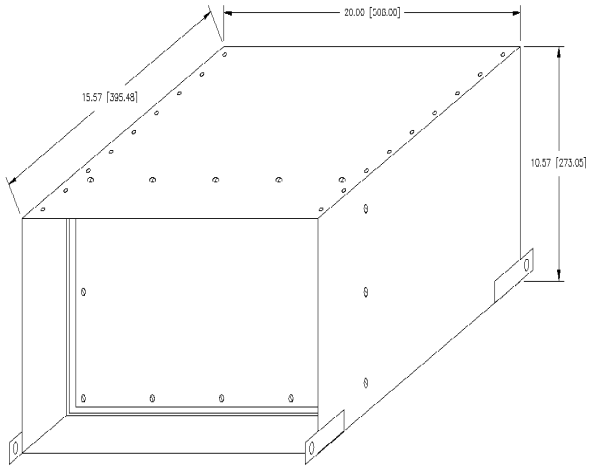

Figure 2. Housing dimensions

System Specifications:

A portion of the photocell matrix to be used in this project is shown in Fig. 1. The actual matrix consisted of an array 40 cells in the horizontal direction and 20 cells in the vertical direction respectively giving a matrix size of approximately 40 cm (16”) by 20 cm (8”).

Each cell was be connected to the microprocessor via a custom built circuit. Thus, a total of 60 (40 + 20) outputs from the matrix was used to track the location of the laser footprint

The laser footprint on the matrix is approximately ¾” in diameter when the mining machine is closest to the laser source, and increases up to the size having approximate diameter of 2½” when the mining machine is furthest from the laser source. Hence, not more than approximately 25 cells are ON at any time in normal operation.

The microprocessor was also configured to produce a digital output signal in the event the laser footprint goes off the matrix. This signal can be used for purposes such as to trigger an alarm or to shut down the machine. To minimize the effect of ambient light on the cell matrix, a laser filter was used. The effect of an unwanted occasional bright light, for example from headlights of automobiles, was filtered out at firmware level.

A prototype of the system was developed. It was tested in-house at the Hinz lab and on site as well. The circuit was then fabricated on printed circuit board (PCB) by using the same components from the prototype. The cell matrix, PCB, microprocessor, and expansion card was housed in ½” aluminum enclosure of approximate size 10” (H) × 18” (W) × 7” (D).

For further information or to contact a Hinz office near you, please check our website at:

www.hinz.com