Design of safety system for autonomous concrete surface processing

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Grinding of concrete surfaces is time-consuming and costly. An autonomous, self-driving, grinding machine would streamline the process and save both time and money. Since these are large and heavy machines a fool proof safety system needs to be developed to protect both people and property.

This can be done by creating a safety zone for the machine to operate in using light grids and mirrors. Light grids are a safety device, consisting of an emitter and a receiver, with the emitter sending pulses of infrared light, not visible for the naked eye, to the receiver. If anything, or anyone were to enter the safety zone, by blocking the infrared beams, the system is notified and the machine shuts down to prevent accidents.

PROBLEM

The goals of the project were the identification of key parameters affecting the setup of the system, the identification of a market segment for the product and a conceptual design of the safety system.

The setup of the system is affected by many factors such as angles, height and placement of the light grids. The light grids are fairly sensitive, and a small movement could break the connection between the light grids. To get a user-friendly system that is easy to use these factors must be taken into consideration during the concept development phase and a solution to help the user be integrated into the final product.

METHOD

The project consisted of two phases. During the first phase, extensive research, interviews and testing were conducted. This was done to understand what the system needs to do and what the customer wants the system to do. The second phase consisted of concept generation and development, in other words, finding the best solution to the problem based upon research and needs. This resulted in the final concept, the Hydra.

CONCLUSION

Named after the beast from ancient Greek mythology, the Hydra consists of five stands or “heads” which the user easily places around the area which needs to be grinded. The system consists of:

- One emitting stand, onto which two emitting light grids are mounted perpendicular to each other.
- Two mirror stands on which the infrared beams are reflected.
- Two receiving stands, with one receiving light grid mounted on each.

The stands are placed in a rectangular pattern with the emitting stand in one corner and both the receiving stands placed in the opposite corner. The mirror stands are placed in the other corners allowing the reflection of the infrared beams between the two sets of light grids. The light grids are correctly aligned using lasers mounted on the emitting stands and laser targets on the mirror and receiving stands.

FUTURE

User tests and tests of early prototypes are showing promising results. The final product is a conceptual system-level design and requires extensive future improvements and testing before introduced to the market.

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