WORKSHOP SAFETY AUTOMATION FOR LATHE MACHINE

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Keywords:

Machine Learning, Python, Real Time Video Capturing, Automation, Safety, Machine, Workshop

Introduction:

In today's universe safety is most significant in workshops, a little ignorance may lead to hazardous accidents, heavy losses and even causing disabilities and loss of precious lives. Due to high cost of negligence ILO (International Labor Organization) estimates over one million work-related deaths occur annually and hundreds of millions of workers suffer from workplace accidents and occupational exposure to hazardous substances worldwide. Thus, with today's emerging technology such as Artificial Intelligence can be implemented along with automation and embedded systems in machine shops to save humans by avoiding hazardous accidents.

Today's Mechanical Engineering is connected to the Electronics and Computer Science Worlds and Artificial Intelligence is implemented around the universe for better productivity, efficiency, accuracy and safety which is meeting the vast demands of humans and also making life lead easier.

Machine learning being a subset of Artificial Intelligence is a Computer System which learns, adapts, predicts and discerns just like a human by algorithms and models in any situation with known or unknown output. Hence, we are using Machine Learning to implement and maintain safety round the clock.

This Workshop Safety Automation System contains Raspberry Pi 4 B Computer Board with Cameras, MQ3 Alcohol Gas Sensor, DC 5V AC 230V Relay connected and mounted on the machine using a fabricated stand. Machine Learning and several programs in python are run in Raspberry Pi and Real Time Video is monitored and with Image Processing and ML the fingers and eyes moment are monitored all the time along with alcohol detection

Objectives:

1. To develop automation system for Lathe machine to safeguard body parts of machine tool operator.
2. Application of Artificial Intelligence and Mechatronics in the automation with Integration of Raspberry Pi 4 B Computer Board, Web Camera, 5V DC 230V AC Relay and Alcohol Sensor.
3. To implement developed automation system to a Lathe machine for ensuring safe and satisfactory operation.
4. Transforming the developed automation into industrial compatible system as per standards which is better scope for future.

Methodology:

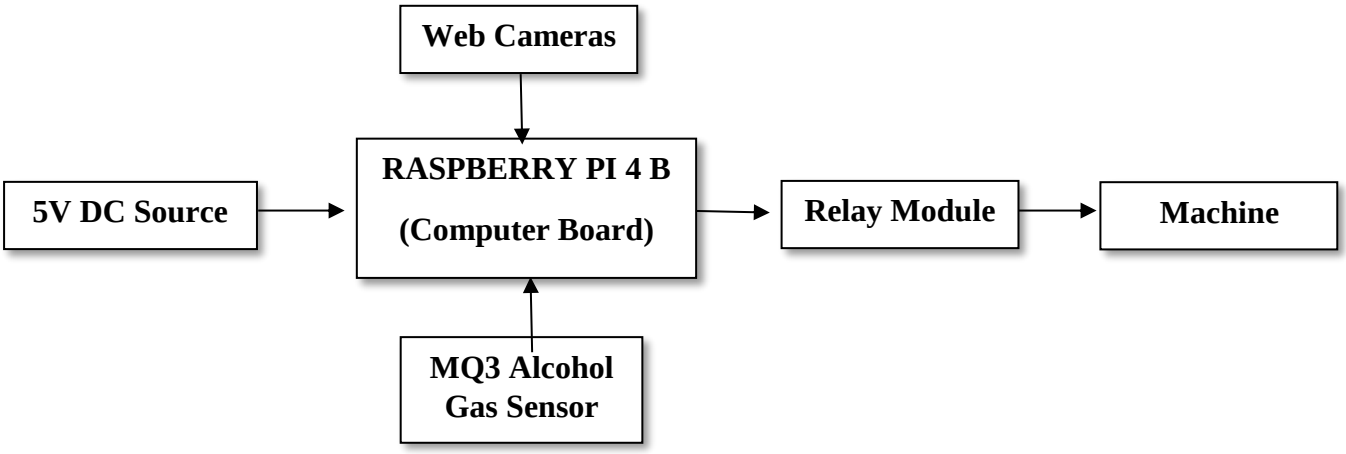

Illustration of components and interface

The system basically contains Raspberry Pi 4 B Computer Board with Cameras, MQ3 Alcohol Gas Sensor, DC 5V AC 230V Relay connected and mounted on the machine using a fabricated stand. Machine Learning and several programs in python are run in Raspberry Pi and Real Time Video is monitored and with Image Processing and ML the fingers and eyes moment are monitored all the time. Whenever fingers move near to moving part such as chuck and workpiece the automation provides a voice-based warning and when they come too closer the voice-based error is provided and machine turns off instantly along with messages sent to appropriate authorities. The same process of warning and error and machine turning off is repeated whenever drowsiness is detected for 8 and 16 seconds respectively. If alcohol is detected machine is turned off.

The programming part is also a crucial part of this project. The programs are basically written in Python with application and implementation of Machine Learning with the help of renowned libraries such as mediapipe and dlib, opencv for real time video capturing, pyttsx3 for text to speech for providing warnings, GPIO and wiringpi for channels control, etc.

The coordinates are plotted on the video where the moments of machine parts such as chuck and workpiece are taking place and distance from finger to camera is also monitored in order to ensure that fingers are not in danger. Using dlib the eye moment is tracked and MQ3 sensor is used to detect the alcohol through smell. Requests is used to send the safety violation messages to the authorities.

A fabricated MS Stand at about 1.5 meters height is mounted over the headstock of the Lathe machine drilled with five M8 tapped holes so that the camera attached to plate can be fitted at different positions to get proper video covered with every moving parts.

Conclusion:


Fig 1

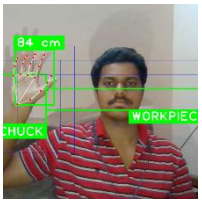

Fig 2

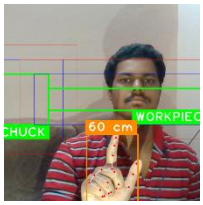

Fig 3

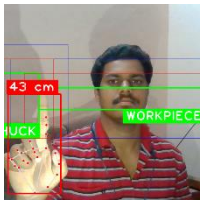

Fig 4


Fig 5


Fig 6

As it can be seen above Fig 1 depicts the connection of Raspberry Pi Computer Board, Camera, MQ3 sensor and basic setup. Figures 2, 3 and 4 are all about example for safety violation where fingers are moved closer to the chuck or work piece a warning has been issued with an orange color box to the palm. Figure 3 shows that the finger is too much closer to moving parts and it might touch the moving parts and cause accidents. Thus, at this stage machine is turned off and message is sent without fail.

Figure 5 and 6 depicts drowsiness test. In figure 5 the eyes are open hence a green curve has been plotted around the eyes whereas in figure 6 the eyes are partially closed hence a red curve has been plotted. If considerable high number of blinks and eyes are being closed for the duration of 8 seconds then a warning is issued whereas if still the same process is repeated for once more 8 seconds consequently then machine is turned off with an error encounter. Machine is turned off along with error and notification if operator is under the influence of alcohol.

Finally it is observed that the automation works successfully and it contributes a lot to ensuring and maintaining hassle free safety round the clock in machine shops. Hence it now reduces a lot of accidents occurring due to little negligence.

Scope for future work:

ML being a subset of AI is emerging in vast manner bringing the technological transformation such as Industrial Revolution 4.0 or Smart Factory. As the project has been worked and demonstrated successfully, it has a more significant scope in the future to develop it into an industrial compatible automation meeting standards. A safety spectacles and other safety gear checking program is also under development and these features can also be added to maintain a better safety and reduce the risk of hazards and accidents.