Research Methodology

The proposed algorithm to implement our research essentially consists of the following parts:

- Object Detection:

  - Object detection lies at the core foundation of our project.
  - Object detection was implemented through OpenCV and the YOLOv5 model
  - YOLOv5 was chosen due to its time tested ability to work on such projects as well as the high levels of accuracy it offers over any previous versions of YOLO
  - The primary requirement of object detection is primarily to ensure the workers on site are wearing their PPE(Personal Protective Equipment) which includes hardhats,goggles,boots and gloves.
  - The presence of other non PPE safety equipment such as harness and imperfection in safety nets were also detected using object detection.
  - All the images were sourced from multiple datasets on Roboflow as it offers a wide range of images with pre existing annotations along with the options to augment the images as well as perform the train and test split

- Fire Hazard Detection:

  - Expanding on the object detection as mentioned above, sparks generated through welding and the presence of inflammable objects on site such as styrofoam,fuel and plastic were also detected.
  - The distance between the sparks and the objects is calculated and based on its variance from a standard parameter which would be based on the history of previous fire accidents on construction sites  and then alerts would be raised.

- HEM Danger Zone detection:

  - The usage of HEMs on construction sites poses a huge risk due to the swinging and gyrational  parts of such machinery.
  - Hence once again making use of object detection all HEMs on site such as JCBs,Bulldozers and Cement Mixers were detected along with the presence of workers and people nearby.
  - The detected vehicle is then checked if it is in motion by using frame differencing and to track it the deepSORT algorithm is used.
  - Then based on existing safety regulations and standards a zone is established around the vehicle and any intrusion into this zone by a person raises an alert.

Depending on dataset availability,time constraints and guide approval the following additional features could be added:

- Crane load fall zone detection

- Building alert systems using tinyML and IOT devices