AI Based Manufacturing Industrial Safety Wear Detection And Pollution Monitoring System

S.Kokila[1], R.Gayathri[2], M.Keshavapriya[3], M.Kavipriya[4], Mrs.K.G.Suhirdham[5]
[1, 2, 3, 4] Dept of Electronics and Communication Engineering
[5]Assistant Professor, Dept of Electronics and Communication Engineering
[1, 2, 3, 4, 5] NSN college of Engineering and Technology, Karur,Tamilnadu,India,

Abstract- *Wearing a safety helmet while working is crucial for protecting workers from head injuries, which can range from mild to severe. In industrial settings, workers are often exposed to hazardous materials, dangerous machinery, and other potential hazards that can cause head injury. A safety helmet can help to prevent head injuries by absorbing the impact of a falling object or other traumatic force. Workers without safety helmets will suffer more injuries in accidents such as falling human body and vertical falling matter. Hence, detecting safety helmet wearing is a vital step of construction sites safety management and a safety helmet detector with high speed and accuracy is urgently needed. However, traditional manual monitor is labour intensive and methods of installing sensors on safety helmet are difficult to popularize. Therefore, this paper proposes a deep learning-based method to detect safety helmet wearing at a satisfactory accuracy with high detection speed This research aims to develop a deep learning-based system for detecting the presence and proper wear of industrial safety helmets. The proposed system is an AI visual examination system that uses a convolutional neural network (CNN) algorithm to detect potential hazards in real-time. The system consists of a camera that captures images of the workplace and a CNN algorithm that analyzes these images to identify potential hazards. The system can identify hazards such as workers not wearing safety equipment, obstructions in walkways, and unsafe working conditions. Once a potential hazard is identified, the system alerts workers to take necessary precautions to avoid accidents. The system will be trained on a large dataset of annotated images to accurately recognize and classify various types of safety helmets and their proper wear this system has the potential to significantly improve the efficiency and accuracy of industrial safety inspections, reducing the risk of head injuries and promoting a safer working environment.In our experimental evaluation, we first compared the five CNNs in terms of classification performance and inference latency. Then, we deployed each CNN on the real system and evaluated the system's throughput regarding the number of video analyze Then system can detect potential hazards in real-time.which allows workers to take necessary precautions to avoid accidents. The system is also cost-effective as it does not require additional manpower or resources. The implementation of this system can ensure a safer work environment for workers and reduce the number of workplace accidents. The proposed technique is to design an efficient system to read and monitor pollution parameters and if any of these factors exceeds the industry standards, immediately the information send to pollution control authority by using IoT methodology. Which will automatically monitor, if any of these parameters affects the system. And also these parameters can be monitor in PC. These systems find the amount of pH present in the industry, level of smoke released, machineries temperature and noise in the industrial environment during industrial process.*

Keywords- Internet of things, IoT edges device security, gas sensor, pH sensor, noise sensor, micro controller.

I. INTRODUCTION

High injury rates characterize many sectors ranging from construction to manufacturing. However, many work accidents can be considered preventable by adopting Personal Protective Equipment (PPE), such as hard hats, shoes, vests, and masks. For instance, more than half (56%) of the accidents in construction sites are caused by the lack of PPE devices. Typical examples of PPEs are helmets, vests, and gloves. Helmets are crucial to prevent fatal accidents in dangerous areas, e.g., the proximity of mechanical lifting devices, automated machinery for assembly line production, or areas with a high risk of falling objects. Safety helmet is one of the effective PPEs to protect workers from the hit of falling object, and it is a statutory requirement all over the world to wear a safety helmet on construction sites. However, safety helmet wearing end to be ignored because of discomfort and weak safety awareness. So inspecting whether workers wearing safety helmet properly is vital for their safety and can improve safety management level Construction is a high-risk business, and safety helmets are the most basic personal protective equipment and are critical to the safety of construction professionals. However, the importance of helmets is often disregarded due to lack of safety awareness. Statistical examination of pertinent data revealed that there were a total of 2133 construction safety production accidents

in the country, with 2478 deaths, with high-altitude falls accounting for 52.41% of all accidents Helmet supervision is an essential part of the building operating environment. Manual supervision methods are commonly used in construction units, but with such excessive scope of supervision, it is impossible in practice to track and manage all workers in a timely manner. Therefore, helmet wearing detection under intelligent monitoring based on image processing is gradually becoming the main means for companies to implement management. The automatic supervision is faster in operation, more reliable with a larger coverage and low cost. As such it is more conducive to achieving the goal of on-site supervision than the traditional methods. Computer vision detection algorithms can be classified into two types: traditional computer image detection algorithms and deep learning detection algorithms.

II. LITERATURE SURVEY

[1] An Industrial Cloud-Based IoT System for Real-Time Monitoring and controlling of wastewater: These plants may not be desined to handle this type of waste and the accelerated deterioration of sewage treatment plant structures.

[2] Deep Learning-Based Workers Safety Helmet Wearing Detection on Construction sites Using Multi- Scale Features This paper proposes a deep learning based method to detect safety helmet wearing at a satisfactory accuracy with high detection speed.

[3] Safety Helmet Wearing Detection Model Based on Improved YOLO-M: In this paper a helmet wearing detection model YOLO-M is proposed.

[4]A Smart System for Personal Protective Equipment Detection in Industrial Environments Based on deep learning At the edge In this Work we Propose a system for real-time PPE detection based on video streaming analysis and deep neural network(DNN)

[5] Incorporate online hard Example mining and Multi-part combination Into Automatic safety Helmet Wearing Detection, in our frame work, we the multi-scale training and the increasing anchors strategies to enhance the robustnesss of the original faster RCNN algorithm to detect different scales and small object. first use

[6] Detection and Locution of Safety Protective Wear in Power Sustain operation using Wear-Enhanced YOLOv3 Algorithm; In this paper , wear –enhanced YOLOv3 method for real-time detection of PSPE and subststion workes is proposed.

[7]A Real-Time Smart Wastewater Monitoring System Using IoT: The proposed model uses a GSM-GPRS module to transfer date to a web server.

[8]Smart Recycle Bin: A Conceptual Approach of Smart Waste Management with Integrated Web System: In this paper, they proposed a smart recycle bin application based on informaction in the smart cart to automatically calculate the weight of waste and convert the weight into point then store it into the card.

III. EXISTING METHODS

The existing work is the system which investigates level of pH in industry effluents, level of CO gas released during industry process and temperature of the machineries. Thus through this project the author tried to prove that control of pollution can be computed. The existing paper concludes that the method is more accurate to drive the desired parameter. So far, research in safety helmets wearing detection mainly focused on hand-crafted features, such as color or shape. With rising success of deep learning, accurately detecting objects by training the deep convolutional neural network (DCNN) becomes a very effective way. This paper presents a deep learning approach for accurate safety helmets wearing detection in employing a single shot multi-box detector (SSD).

Manual Clearance:

A trained individual with metal detectors find the mines and then they are destroyed through controlled explosion. This is a procedure where the de-miner first scans the ground with metal detector, and then uses probe to identify the signaled object to carefully uncover it. Each alarm is carefully checked for its understanding and removal. However, it's observed that one in every 1000 signal detected is a mine. It is a very slow process considering every forward movement should be thoroughly examined before risking to step ahead. Additionally, since the bullet casting and other metals might be detected using metal detectors, the false indications further delay the procedure.

A.DRAWBACKS

- Low accuracy
- Limited scalability
- Difficulty in detection overlapping objects
- Sensitivity to input image quality
- Training complexity

IV. PROPOSED METHOD

The proposed system aims to use AI technology to improve safety in the manufacturing and construction industry by detecting whether workers are wearing safety helmets in the workplace. This will help to prevent accidents and fatalities, which are unfortunately common in these industries.*The system will use a Convolutional Neural Network (CNN) algorithm, which is a type of deep learning algorithm this particularly well-suited for image recognition tasks. The algorithm will be trained* on a large dataset of images of workers in different manufacturing and construction settin some wearing safety helmets and others not wearing them. The dataset will be labeled to indicate whether each image shows a worker with or without a safety helmet.If the algorithm detects a worker who is not wearing a safety helmet, and then recognize the workers face with employee database at construction site or manufacturing industry. The recognized worker / person details will be sent to a designated supervisor or safety officer. So that the supervisor can take appropriate action to ensure that the worker puts on a safety helmet before continuing work.In our proposed method the industrial pollution parameters are continuously sensed from different sensor, initially, to sense the different factors like Gas level, pH, temperature level, and noise. The output of sensors is an analog form so controller needs ADC module. Which can convert analog signals from sensor to digital signals that is controller readable form. If anyone parameter exceeds its standard level, these information will send to control authority through ToT module. Another important step is these parameters can be monitor through internet by using Cloud.

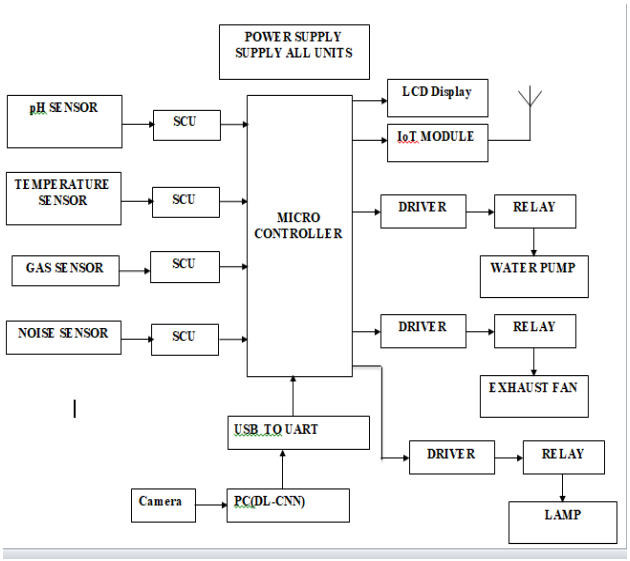
ADVANTAGES

- Improved safety
- Increased efficiency
- Better compliance
- Enhanced data collection
- Reduced cost
- Easy integration

METHODOLOGY

Convolutional Neural Networks (CNNs) are the most common deep learning technique used for image classification tasks such as detecting safety helmets. The methodology involves training the neural network with a large dataset of images of people wearing safety helmets and without safety helmets. The CNN algorithm involves a series of convolutional layers that apply a set of filters to the input image, followed by pooling layers that down sample the feature maps. The output of the pooling layers is then fed into fully connected layers that classify the input image. In safety helmet detection, the CNN algorithm can be used to identify whether a person is wearing a safety helmet or not. This can be achieved by training the network on a large dataset of images of people wearing safety helmets and without safety helmets .Overall, safety helmet detection using the CNN methodology is an effective way to ensure safety in construction sites, factories, and other high-risk environments where wearing safety helmets is essential.

BLOCK DIAGRAM



V. HARDWARE DESCRIPTION

A.METAL DETECTOR

A Metal sensor is a sensor able to detect the presence of nearby objects without any physical contact. The maximum distance that this sensor can detect is defined "nominal range". Some sensors have adjustments of the nominal range or means to report a graduated detection distance. They are also used in machine vibration monitoring to measure the variation in distance between a shaft and its support bearing. This is common in large steam turbines, compressors, and motors that use sleeve-type bearings.

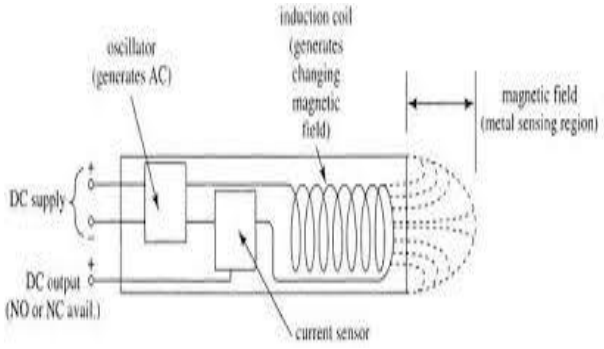


Fig 2. Operating principles for Metal sensor

Type	Use
Inductive	Detection of metallic objects
Capacitive	Detection of metallic and non-metallic objects
Photoelectric	Use light sensitive elements to detect objects

B. TEMPERATURE SENSOR

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature(in 0c).Temperature sensor is used to detect the room temperature level of the surface area .It is controlled by raspberry pi-3 and the information are sent through IoT to the PC. Temperature sensor is connected to the A0 pin in the raspberry pi 3. This sensor is raise above 40 degree to produce alarm sound from the buzzer.

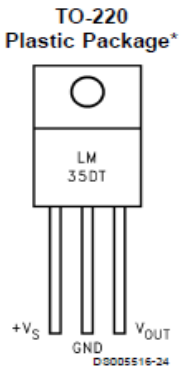


Fig 3. Pin diagram of LM35

C. GAS SENSOR:

Gas sensor is used to detect the presence of gases in an area often as part of a safety system. MQ-4 detect natural gas concentrations anywhere from 200 to 10000ppm. A gas detector can sound an alarm to operators in the area where the leak is occurring and simultaneously send the information to the PC through IoT. Gas sensor is connected to the A1 pin of the raspberry pi 3. This sensor is to intimate an alarm sound above 100cm range.

Fig 4. Gas sensor

D. NOISE SENSORS:

A Sound sensor is defined as a module that detects sound waves through its intensity and converting it to electrical signals. Sound sensor consists of an in-built capacitive microphone, peak

Fig 5. Noise sensor

E.pH SENSOR:

Ph sensor is one of the most important tools for measuring pH and is commonly used in Water quality monitoring. This type of sensor is capable of measuring alkalinity and acidity in water and other solutions. When used properly , pH sensors can ensure the quality of products and process that occur in wastewater or manufacturing plants.

Fig 6. pH sensor

F. POWER SUPPLY:

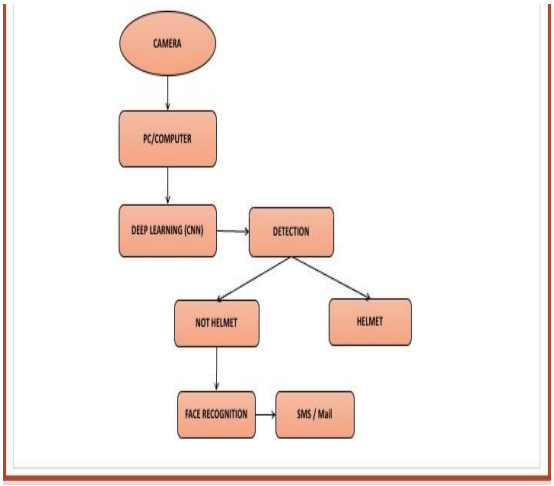
Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. 12v battery is fixed to supply the DC motor for locomotion of the wheels.

G. MICRO CONTROLLER:

A microcontroller is a compact integrated circuit designed to glover a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip

Fig 7. Microcomtroller

VI. BLOCK DIAGRAM



BLOCK DIAGRAM EXPLANATION:

CAMERA**:** camera is a key component of our project, because we process the real time data where captured by camera. so we need to connect the camera first and captured the real time data using it.

PC / COMPUTER: Next, we must connect the camera to our system in order to detect people who do not wear safety helmets in industries. So we connect the **c**amera to our computer because the computer can store the algorithm used to detect the object.

MODEL: The next step in our project is to send the captured image to the deep learning algorithm via computer, and our model will detect the specific object in the captured images. Our deep learning model handles this process.

DETECTION: Detection process in deep learning models refers to the process of identifying objects, features, or patterns in data using a deep learning algorithm. In deep learning, object detection is a task that involves identifying and locating objects within an image or video. To perform this task, several deep learning algorithms are used, including convolutional neural network and etc..

ALERT SMS: Finally, we detect the object using captured images and determine whether or not the helmet is detectable. If the helmet is not detected by the model in the image, our model will send an alert message to a higher-ranking official via Twilio.

H. IOT

In this project we introduced a special technique IoT. IoT allows objects to be sensed or controlled remotely across existing network infrasture creating opportunity for more direct integration of the physical world in to the computer-based systems and result in improved efficiency, accuracy, and economic benefit in addition to reduced human intervention.

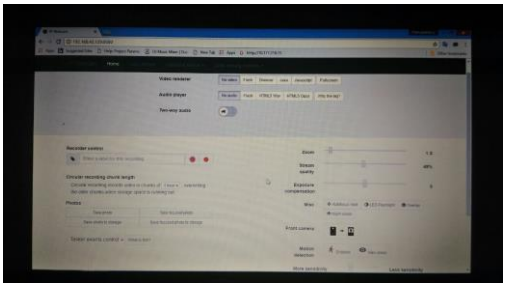
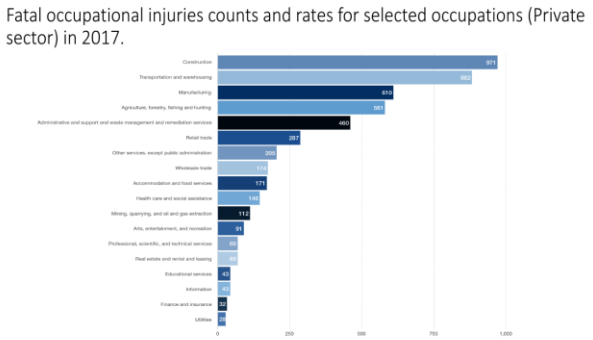
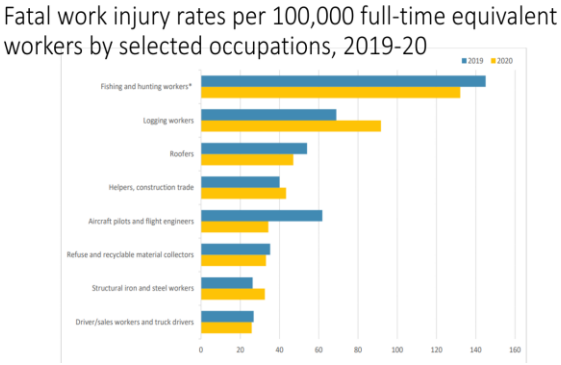


Fig 9. Things speak web page





SOFTWARE REQUIREMENTS

HARDWARE SPECIFICATION

System : PC OR LAPTOP
Processor : INTEL 15
RAM : 4 GB Recommended
ROM : 100GB

SOFTWARE SPECIFICATION

OPERATING SYSTEM : WINDOWS7/10/11
LANGUAGE USED : PYTHON

VII. MODULES

- IMAGE DATASET COLLECTION
- IMAGE PREPROCESSING
- IMPORTING MODULES
- TRAINING THE DATASET
- CAMERA INTERFACING
- FACE RECOGNITION
- TEST THE OUTPUT
- ALERT MODULE

VIII. CONCLUSION

The purpose of a safety helmet detection project in industries is to ensure the proper use of personal protective equipment (PPE) among workers and to enhance workplace safety. The project aims to automatically detect if a worker is wearing a safety helmet and alert them or a supervisor if they are not .This can be done using computer vision and machine learning techniques to recognize the presence of a helmet in real-time and raise an alarm if it is not detected. The ultimate goal is to reduce the risk of head injuries and promote a safe working environment for all employees.

Fig. 3: Interest of head region

IX. FUTURE SCOP

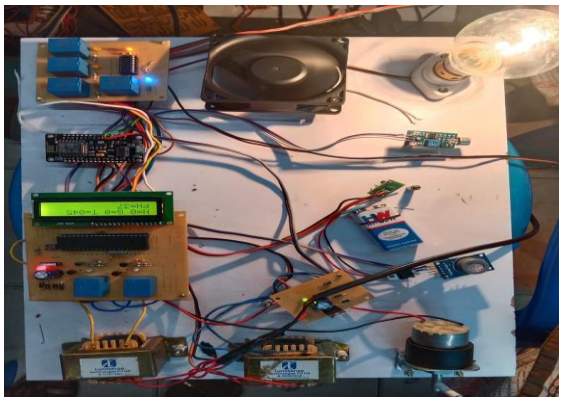
The development of safety helmet detection in industries is likely to continue in the future, with the following trends and advancements being some of the most important:

1. Improved accuracy**:** Future developments in deep learning and computer vision are likely to lead to more accurate safety helmet detection systems, with the ability to better detect helmets in complex and challenging environments.

2. Enhanced usability: The systems are likely to become more user-friendly and easier to use, with improvements in the user interface and increased automation.
3. Integration with other safety systems: Safety helmet detection systems are likely to become more integrated with other safety systems, such as fire alarms and evacuation plans, to create a comprehensive safety management system.
4. Increased deployment in new industries**:** The deployment of safety helmet detection systems is likely to expand into new industries, such as construction, manufacturing, and transportation, to improve the safety of workers in hazardous environments.
5. Wearable technology**:** The development of wearable technology, such as smart helmets and body-worn cameras, is likely to lead to new safety helmet detection systems that are more robust and accurate, while also providing additional safety-relatedinformation

X. RESULT

The various industrial pollutants are detected and measured with the help of various sensor .these values converted into digital values and are transmitted to the in respective authority via IoT communication. These parameter can be monitored via internet through cloud server software there by providing real-time monitoring this work presents the design of a system to give a result for detecting industrial - causing environmental pollution. It may enable to reduce the pollution level over a certain spin of time. This method may be integrated as an enabling tool to design intelligent transportation system for smart city. The performance and robustness of the pollution monitor and control system can be in additional to improve causing parameters. there by enhance the industrial and natural environmental. We can use this methodology in the MSEB board also. The safety helmet detection system using CNN with Adriano and IoT is and innovative solution that can help improve safety in various industries.



REFERENCES

[1] M. D. Benedetto, F. Carrara, E. Meloni, G. Amato, and C. Gennaro, ‘‘Learning accurate personal protective equipment detection from virtual worlds,’’ Multimedia Tools Appl., vol. 80, pp. 1–13, Aug. 2020.

[2] Y. Li, H. Wei, Z. Han, J. Huang, and W. Wang, ‘‘Deep learning-based safety helmet detection in engineering management based on convolution neural networks,’’ Adv. Civil Eng., vol. 2020, pp. 1–10, Sep. 2020.

[3] R. R. Cabahug, ‘‘A survey on the implementation of safety standards of on-going construction projects in Cagayan de Oro City, Philippines,’’ Mindanao J. Sci. Technol., vol. 12, no. 1, pp. 12–24, 2014.

[4] B. Wan. W. Li, and H. Tanger, ‘‘Improved YOLOv3 algorithm and its application in helmet detection,’’ Computer. Eng. Appl., vol. 56, no. 9, pp. 33–40, 2020.

[5] S. H. Kim, C. Wang, S. D. Min, and S. H. Lee, ‘‘Safety helmet wearing management system for construction workers using three-axis accelerometer sensor,’’ Appl. Sci., vol. 8, no. 12, p. 2400, Nov. 2018.

[6] A. Kelm, L. Laußat, A. Meins-Becker, D. Platz, M. J. Khazaee, A. M. Costin, M. Helmus, and J. Teizer, ‘‘Mobile passive radio frequency identification (RFID) portal for automated and rapid control of personal protective equipment (PPE) on construction sites,’’ Autom. Construct., vol. 36, pp. 38–52, Dec. 2013.

[7] S. Dong, Q. He, H. Li, and Q. Yin, ‘‘Automated PPE misuse identification and assessment for safety performance enhancement,’’ in Proct .Into .Conf. Construct. Real Estate Managers.. Sep. 2015, pp. 204–214.

[8] J. Shen, X. Xiong, Y. Li, W. He, P. Li, and X. Zheng, ‘‘Detecting safety helmet wearing on construction sites with bounding-box regression and deep transfer learning,’’ Computer.-Aided Civil Infrastructure. Eng., vol. 36, no. 2, pp. 180–196, Feb. 2021.

[9] Q. Fang, H. Li, X. Lou, L. Ding, H. Lou, T. M. Rose, and W. An, ‘‘Detecting non-hardhat-use by a deep learning method from far-field surveillance videos,’’ Automat. Construct. vol. 85, pp. 1–9, Jan. 2018.

[10] Z Chi and T. Ellis, ‘‘Self-adaptive Gaussian mixture model for urban traffic monitoring system,’’ in Proc. IEEE Int. Conf. Computer. Vis. Workshops (ICCVWorkshops), Nov. 2011,. 1769–1776.

[11] N. Dallas and B. Trigs , ‘‘Histogram of oriented gradients for human detection,’’ in Proc. IEEE Computer. Soc. Conf. Compute. Vis. Pattern Recognition., Jun. 2005, vol. 1, no. 1, pp. 886–893.

[12] C. J. C. Burges, ‘‘A tutorial on support vector machines for pattern recognition,’’ Data Mining Knowl. Discovery. vol. 2, no. 2, pp. 121–167, 1998.

[13] P. Chansik, L. Doyeop, and K. Numan, ‘‘An analysis on safety risk judgment patterns towards computer vision based construction safety management,’’ in Proc. Creative Construct. E-Conf. Budapest, Hungary: Budapest University of Technology and Economics, 2020, pp. 31–38.

[14] X. Liu and X. Yes, ‘‘Skin color detection and Hu moments in helmet recognition research,’’ J. East China Univ. Sci. Technol., Natural Sci. Ed., vol. 40, pp. 365–370, Jun. 2014.

[15] A. H. M. Rubaiyat, T. T. Toma, M. Kalantari-Khandani, S. A. Rahman, L. Chen, Y. Yes, and C. S. Pan, ‘‘Automatic detection of helmet uses for construction safety,’’ in Proc. IEEE/WIC/ACM Int. Conf. Web Intell. Workshops (WIW), Oct. 2016, pp. 135–142.