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Proceedings of International Conference on Computational Intelligence and Emerging Power System

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Preface

The International Conference on Computational Intelligence and Emerging Power System (ICCIPS 2021) is the first International Conference that has been organized with the publication support of Springer. It is jointly organized by the Department of Electrical Engineering and Department of Computer Science of Engineering College Ajmer under TEQIP III. The objective of the conference was to bring together people with common ideas and to discuss issues related to artificial intelligence, machine learning, IoT, intelligent algorithms, swarm optimizations, big data, and their applications in power system, energy optimization, power optimization, power system, smart grid and renewable energy system, etc. The aim was to involve graduate students, research scholars, faculty, and industry persons to present their research work, theories, and ideas. The conference has been planned in three tracks, viz, Track-1 Computational Intelligence, Track-2 Emerging Power System, and Track-3 Renewable Energy System.

On behalf of Engineering College Ajmer, we are pleased to welcome all the readers of the Proceedings of the International Conference on Computational Intelligence and Emerging Power System (ICCIPS 2021). This conference has provided an environment to conduct intellectual discussions and exchange ideas that are instrumental in shaping the future of artificial intelligence. The conference got an overwhelming response with 150 institutes participating from India and other countries like Portugal, Algeria, Ethiopia, etc. A total of 185 papers were received and peer-reviewed by reviewers from different reputed institutions across India. A total of 30 papers were selected for presentation at the conference. All selected papers were registered and presented during March 9–10, 2021.

We are thankful to Engineering College Ajmer for giving us this opportunity to organize this conference under the TEQIP III project.

Sharjah, United Arab Emirates — Ramesh C. Bansal
Talence Cedex, France — Akka Zemmari
Ajmer, India — K. G. Sharma
Ajmer, India — Jyoti Gajrani

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About the Editors

Prof. Ramesh C. Bansal has more than 25 years of diversified experience of research, scholarship of teaching and learning, accreditation, industrial, and academic leadership in several countries. Currently, he is Professor in the Department of Electrical Engineering at University of Sharjah. Previously, he was Professor and Group Head (Power) in the ECE Department at University of Pretoria (UP), South Africa. Prior to his appointment at UP, he was employed by the University of Queensland, Australia; University of the South Pacific, Fiji; BITS Pilani, India; and Civil Construction Wing, All India Radio. He has significant experience of collaborating with industry and government organisations. He has made a significant contribution to the development and delivery of BS and ME programmes for utilities. He has extensive experience in the design and delivery of CPD programmes for professional engineers. He has carried out research and consultancy and attracted significant funding from industry and government organisations. He has published over 325 journal articles, presented papers at conferences, books, and chapters in books. He has Google citations of over 11000 and h-index of 50. He has supervised 25 Ph.D., 4 postdocs, and currently supervising 5 Ph.D. students. His diversified research interests are in the areas of renewable energy (wind, PV, microgrid), power systems, and smart grid. He is Editor/Associate Editor of several highly regarded journals including IEEE Systems Journal, IET Renewable Power Generation, and Technology and Economics of Smart Grids and

Sustainable Energy. He is Fellow and Chartered Engineer IET-UK, Fellow Institution of Engineers (India), and Senior Member of IEEE-USA.

Dr. Prof. Akka Zemmari is an associate professor at LaBRI, University of Bordeaux—CNRS. He received his Ph.D. degree and his HDR in Computer Science from Université Bordeaux in 2000 and 2009, respectively. His research areas deal with (1) the design, the analysis, and simulation of distributed algorithms, (2) the static/dynamic analysis of programs with application to malware detection, and (3) machine and deep learning with application to security aspects and to image analysis. Currently, he is serving as the head of Distributed Algorithms research group in LaBRI, the computer science research laboratory of the University of Bordeaux. He is PI/Co-PI of six research projects which also includes Joint Indo-French projects. He has acted as a referee for the many international journals and international conferences. He has published over 30 research articles in reputed journals. He has published over 50 research articles in reputed conferences. He has published a book on Deep Learning in Mining of Visual Content with Springer Briefs in Computer Science ISBN 978-3-030-34376-7.

Dr. K. G. Sharma is an associate professor and the head of Electrical Engineering (EE) at Govt. Engineering College Ajmer, Rajasthan. He is contributing in the engineering profession since 20 years. He received the B. Tech. degree in EE from CTAE, Udaipur, M.Tech. in Power System from MNIT, Jaipur, and Ph.D. degree in EE from RTU, Kota. He published 25 national and international research papers, presented papers at conferences, authored 01 book, received education excellence award, and supervised more than 10 PG students. He is qualified as certified energy auditor of BEE. He is PI/Co-PI of three CRS projects under TEQIP-III. He has got two patents. His diversified research interests are in the areas of power system stability, renewable energy sources, spectral analysis, power system dynamics and control. Dr. Sharma is a fellow of the Institution of Engineers India, Life Member of Indian Society for Technical Education (ISTE), Member of ISHRAE and ISLE, Member of Soft Computing Research Society. He is a member of various prestigious boards, DRC, inspection committee of university and AICTE. He has delivered several expert talks. He is a reviewer of many repute Journals of Research along with several international conferences. He has organized FDPs/STC/workshops along with one international conference.

Dr. Jyoti Gajrani is an assistant professor and the head of the Department of Computer Science and Engineering at Engineering College Ajmer (Rajasthan). She completed B.Tech. in Computer Engineering from Mody Institute of Engineering and Technology, Lakshmangarh, Rajasthan, M.Tech. in Computer Engineering from the Indian Institute of Technology, Bombay, and Ph.D. in Computer Science and Engineering from Malaviya National Institute of Technology, Jaipur. She has 15 years of teaching and research experience. She has successfully supervised 05 M.Tech. scholars and 05 are currently working. Her research interests include the area of security and privacy, computational intelligence, operating system, and system software. She has received special reorganization by Dr. Nitin Deep Blaggan, Ex-SP Ajmer for development of Ajmer Police Traffic App. She is Co-PI in project titled "Performance Measurement of Security Algorithms on IoT Devices" under competitive research scheme by Rajasthan Technical University (TEQIP-III) with grant of 2.4 lakh. She has published around 40 research papers in reputed international journals and conferences including SCI and Scopus indexed papers. She is the author of one book on Telecommunication Engineering Fundamentals. She has delivered several expert talks. She is reviewer of IETE Journal of Research (Taylor and Fransis) and ACM DTRAP along with several international conferences ICCIS 2020, ICDLAIR2019, INDICON 2019, SIN 2017, SIN 2018. She has organized more than 30 FDPs, STCs hackathons, and international conferences.

Chapter 1
Reading Gauges Using Computer Vision

Dalvi Ameya, Ketkar Prathmesh, Dani Chinmay, Mundada Kapil, Gujarathi Mohnish, and Iyer Anand

1 Introduction

In the process industry like Oil and Gas sector, chemical plants and operations industry, analogue pointer-type gauges are prominently used. For such gauges, readings can be obtained only by visual inspections which require a technician to travel to the gauge location and log the current reading which can be further used in different operations. This method is time consuming, unsafe and is susceptible to human errors. An alternate approach to reading analogue gauges is to capture an image or record a video and use computer vision techniques. Using Open CV Image processing tool in Python Environment and some functions help in reading the present value [3]. That value will be directly stored in the database, so that it can be viewed in future anytime. Also, the graphic user interface (GUI) is created, so that operator in the control room can easily see the gauge and respective reading.

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2 Literature Review

In today's world of automation, the majority of the work is done by machines and robots. The use of advanced technologies like Image processing, the Internet of Things, Artificial Intelligence, etc. is increasing nowadays in Process Industries also. This part focuses on the approaches used by some publication papers that have an aim to build similar models. Depending upon the best suitable approaches, we also suggest our approach for the model. These papers majorly make use of technologies like pyzbar and OpenCV [4]. This section tells us about what were the methodologies and approaches that were used by the authors, whose papers were reviewed.

Section of Media Technology, Aalborg University, Denmark 2EnviDan, Aalborg, Denmark, has presented a paper on r automated recognition and translation of pointer movement in analogue circular gauges. The proposed method processes an input video frame-wise in a module-based manner. Noise is minimized in each image using a bilateral filter before a Gaussian mean adaptive threshold is applied to segment objects. Subsequently, the objects are described by a set of proposed features and classified using probability distributions estimated using Expectation Maximization. The pointer is classified by the Mahalanobis distance and the angle of the pointer is determined using PCA. The output is a low pass filtered digital time series based on the temporal estimations of the pointer angle. https://core.ac.uk/download/pdf/304612162.pdf.

Jianbo Song and Lei Zhang, aimed at the problem of automatic interpretation of analogue instrument's dial indicating data, making the automatic interpretation solution, analysing the relevant techniques and solving the key technical problems, so as to provide a reference for realization of automatic calibration for an analogue meter.

3 Methodology

In the proposed approach, Python as the programming language is used and OpenCV and Pyzbar Libraries are the main tools.

The following methodology has been used to read gauges of different types:

- Circular Gauge with Pointer pivot in the centre.
- Circular Gauge with Pointer pivot just below centre.
- Rectangular Gauge with Pointer pivot at a corner.
- Circular Gauge with Pointer of a different colour.

3.1 Database Creation

Excel is used to create the database. The database will have the following information of every gauge that it has to read:

- Gauge shape (round, square).
- Gauge dimension in mm.
- Pointer Colour.
- Pointer pivot position (coordinates).
- Pointer length.
- Pointer tail length.
- Scale Minimum.
- Minimum scale position angle.
- Scale maximum.
- Maximum Scale position angle.
- Units.

The above information of a gauge will be required to get the gauge reading. Records of a particular gauge are accessed using the QR code.

3.2 QR Code Reading

QR codes are often used to contain web address information and links. In this particular case, QR codes are used to detect a gauge in the process industry and to access information about that particular gauge in the database.

The QR code will be placed near the gauge and will be read using the Camera. The database record to which the QR code will point has the necessary information required to read gauges. This simplifies the process of detecting gauge in the industry environment and also saves the processing time (see Fig. 1).

3.3 Reading Gauge and Storing Value

The following steps are used to get the gauge reading from the image:

- Coordinates of the needle pivot and the length of the needle are extracted from the database.
- For locating the gauge needle, radial lines are drawn from the gauge centre to the pixels on the circumference and the line with the darkest average pixel value will be the needle [5].
- The needle angle is calculated from the lowest point on the circle circumference and the angle is converted to appropriate reading [6].

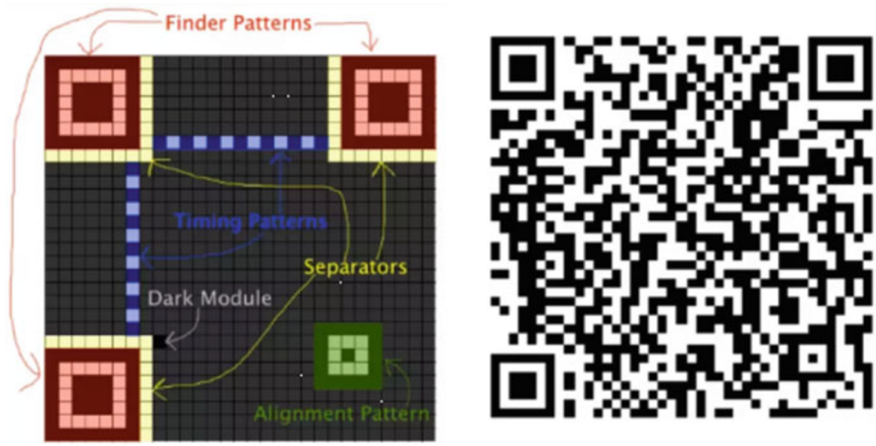
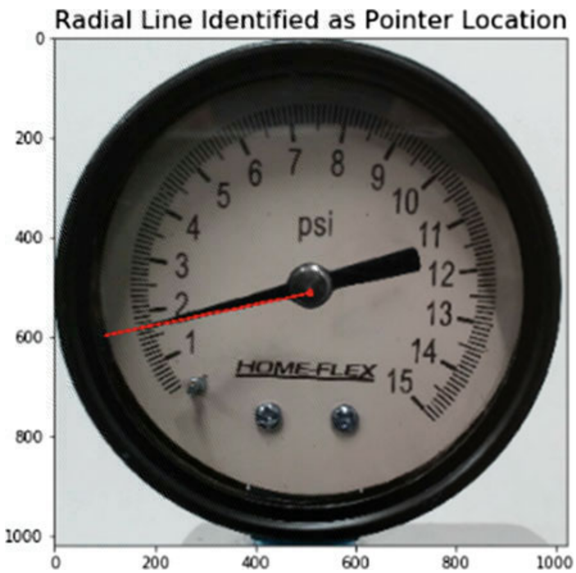


Fig. 1 Finding patterns in QR code

Fig. 2 Radial lines identified as pointer location



- The gauge reading will be directly stored in the database, for inspection purpose (see Figs. 2 and 3).

3.4 Testing

For testing the algorithm, images of the gauge dial and needle are considered (Fig. 4).

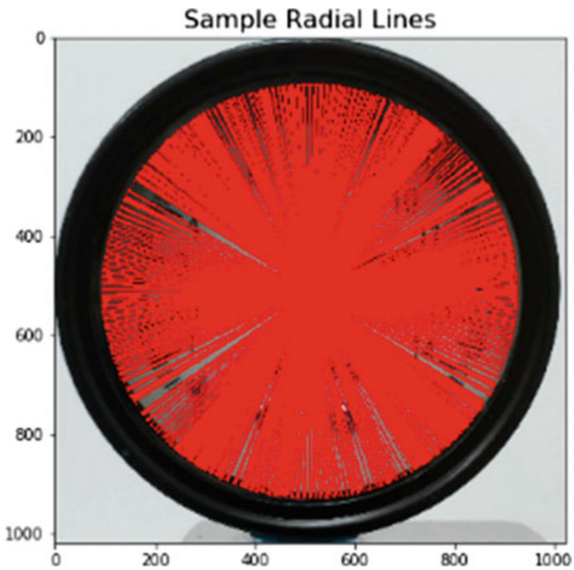


Fig. 3 Sample radial lines

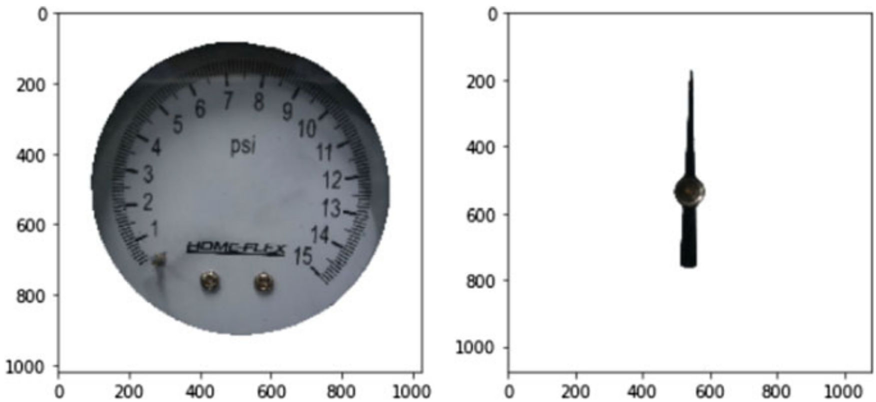


Fig. 4 Gauge dial and gauge needle

These images are used to create synthetic images for testing the algorithm by rotating the needle on the gauge dial to get different gauge readings. For this purpose, the following steps are performed [7]:

- Determining angle corresponding to the minimum scale reading on the gauge and set needle at that particular angle.
- Iterate over the range between the minimum scale angle and the maximum scale angle.
- Create the image with the labels in gauge units instead of degrees and the following is the result (see Fig. 5).

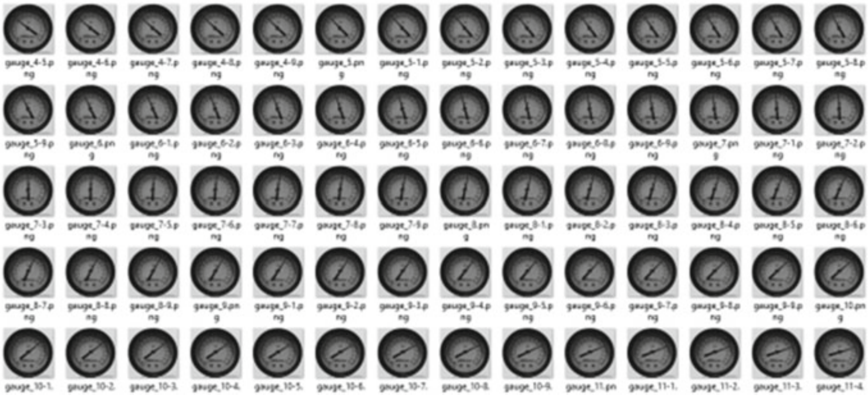


Fig. 5 Synthetic Images for testing the proposed methodology

3.5 GUI

A simple GUI is designed for importing images and then running the program with the imported image as an input. The imported image is displayed in the GUI. The image is pre-processed and the steps for reading gauges are carried out as explained above. The final result is displayed in the same. The final image result is displayed in the GUI with the gauge reading (see Fig. 6).

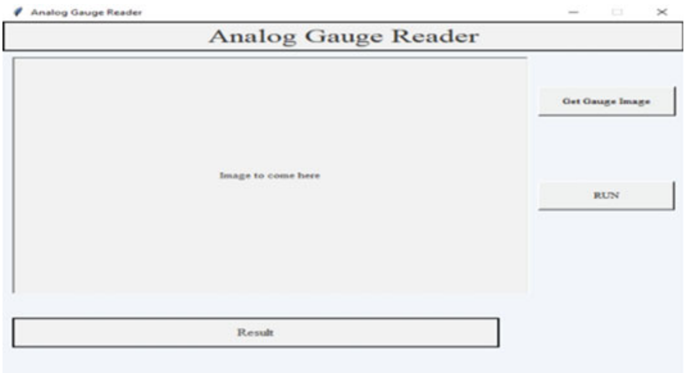


Fig. 6 GUI

Fig. 7 GUI with final results

4 Results

4.1 GUI

A GUI is designed to view the image as well as the results on the interface. The required image is selected using the 'Get Gauge Image' button and then the program runs by clicking on the 'Run'. Then the gauge reading appears in the 'Result' box (see Fig. 7).

4.2 Database

The gauge parameters such as gauge location, shape, pointer radius and centre coordinates are stored in the database given below. Once the program is executed, the present value of the gauge is then stored in the database (see Fig. 8).

4.3 Testing

The gauges used for testing are of different shapes, sizes and different pointer colours.

(a) Test 1: The input image is a pressure gauge with a range of 0–15psi. The shape of the gauge is round and the pointer colour is black. The output image shows the gauge reading that is 1.92 psi (see Fig. 9).
(b) Test 2: The input image is a voltmeter with a range of 0–300 V. The shape of the gauge is rectangular with a black pointer. The output image shows the reading as 0 V (see Fig. 10).

	A	B	C	D	E	F	G	H	I	J	K
1	Sr no	1	2	3	4	5	6	7	8	9	10
2	Type of Gauge	test_11	test_8	test_9	test_12	ure Gauge	test_15	test_10	test_20	test_21	test_13
3	Gauge Location	1A	1B	1C	1D	2A	2B	2C	2D	3A	3B
4	Shape	Rectangle	Round	Rectangle	Rectangle	Round	Rectangle	Round	Round	Round	Square
5	Radius	82	60	80	122	416	221	80	300	85	90
6	Color of pointer	Black	Black	Black	Blue	Black	Black	Black	Black	Red	Red
7	Pointer_x	540	703	708	680	511	785	583	855	726	275
8	Pointer_y	494	273	318	366	513	295	328	468	424	208
9	Length	82	60	80	122	416	221	82	300	85	90
10	Tail length	82	60	80	122	516	470	82	300	85	90
11	min_angle	90	50	90	90	46	90	90	130	135	140
12	max_angle	180	310	180	180	330	180	180	228	228	220
13	min_scale	0	0	0	0	0	0	0	-10	0	0
14	max_scale	500	300	100	300	15	500	30	10	300	500
15	Unit	Volts	psi	KW	Volts	psi	Volts	Amp	Volts	Volts	Volts
16	Current Value	3.978666364	-0.070135913	0.816134483	0	1.920401	2.906859	9.180131	0.047138	39.56379	278.4253
17											
18											

Fig. 8 Database snapshot

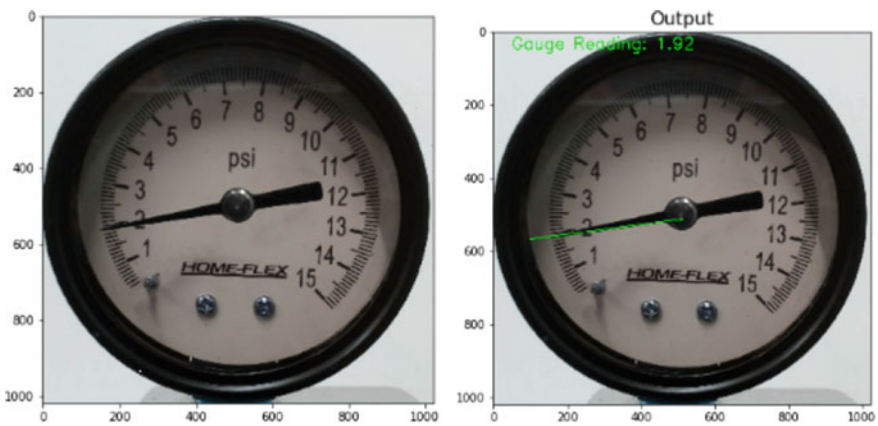


Fig. 9 Result of Test 1

(c) Test 3: The gauge is a voltmeter having a rectangular shape with a range of 0–300 V. The peculiarity of the gauge is that it has a pointer of red colour. The algorithm is able to detect the pointer successfully and the final value is 39.56 V (see Fig. 11).

(d) Test 4: The input image is the voltmeter and the ammeter of a single-phase submersible pump captured by a mobile camera in natural conditions. The voltmeter range is 0–300 v and the ammeter range is 0–30 A (see Fig. 12).

(e) Test 5: The input image is a power gauge in KW ranging from 0–100 KW. It has rectangular shape with a black colour pointer. The gauge reading comes out to be 0.82 KW as the pointer is very close to 0 KW (see Fig. 13).

(f) Test 6: The input image is a voltmeter with a range of −10–10 V. The shape of the gauge is round and the pointer colour is black (see Fig. 14).

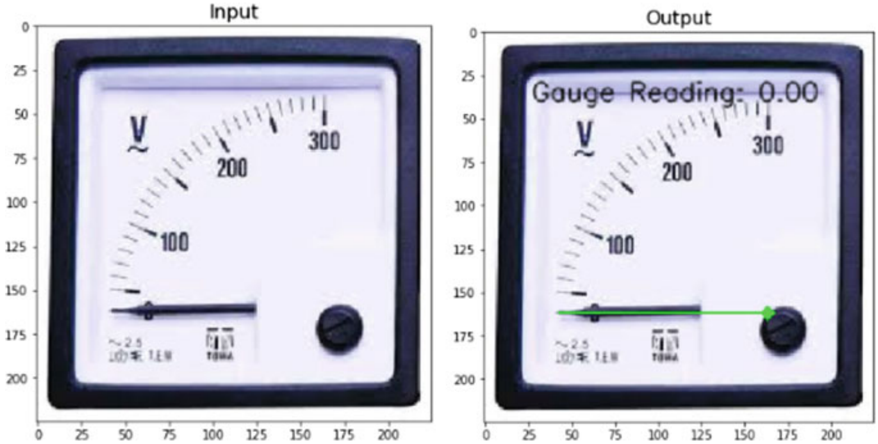


Fig. 10 Result of Test 2

Fig. 11 Result of Test 3

Actual image
Ammeter reading(4.05A) Voltmeter reading(3.98V)

Fig. 12 Result of Test 4

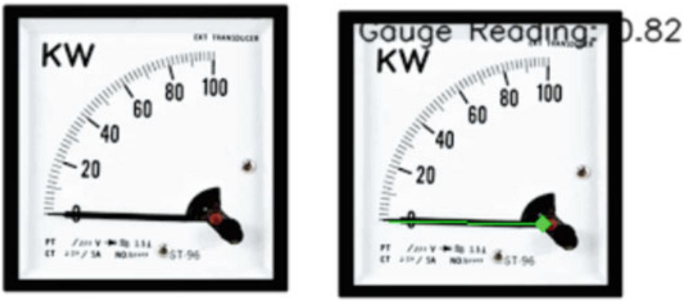


Fig. 13 Result of Test 5

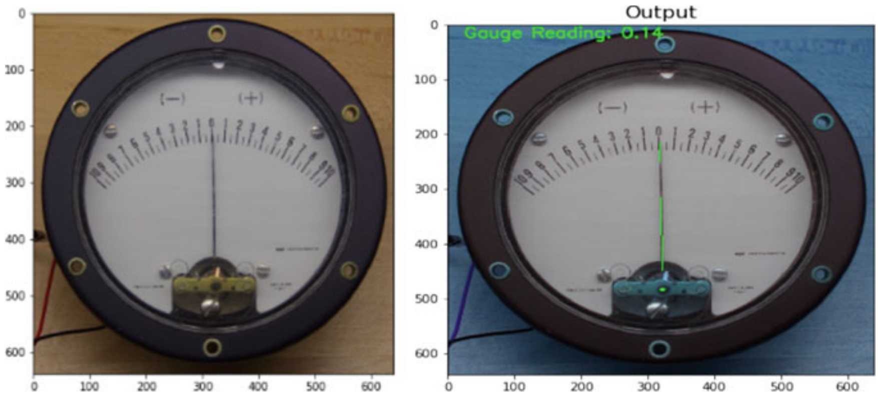


Fig. 14 Result of Test 6

(g) Test 7: The input image is a speedometer with a range of 0–160kmph. The glass of the speedometer is covered with fog and the image is slightly blurred. The algorithm is not able to detect the pointer location due to fog and it is giving a false location (see Fig. 15).

5 Conclusion

The proposed approach is successfully able to decode QR codes to get information from the database and that information is successfully used to read gauges using Computer vision tools in Python.

- The proposed approach aims to read analogue gauges using computer vision tools.
- The proposed approach yields successful results for gauges of various shapes, different pointer positions and different pointer colours.
- The proposed approach is designed in a way to effectively use the computational power of the robot and not overuse it.

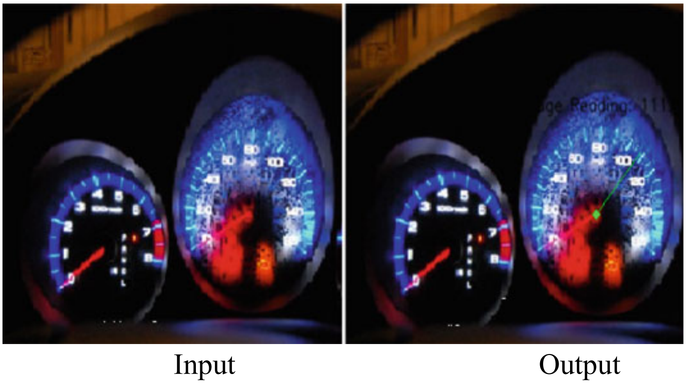


Fig. 15 Result of Test 7

- For better accuracy and results, the information in the database has to be correct and the input images need to be clear.
- For better results, the position of the barcode and the gauge should be fixed.
- It is observed that the approach doesn't work for images with fog on them.
- The proposed approach can be deployed in a test environment and will be suitable for use for purposes stated in the project.

6 Future Scope

- A more robust approach can be used to read gauges with fog.
- The database can be periodically checked and updated for getting errorless results.
- The proposed approach can be modified to work on videos as well.

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Chapter 2
Efficient Classification for Age and Gender of Unconstrained Face Images

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1 Introduction

Classification of age and gender is part of the facial analysis which has been becoming popular in the computer vision community. In the wild means that the classification or the analysis is done on the images that are not taken in the controlled environment so, they tend to mimic the real world pretty well. A highly accurate age and gender classification system can provide various applications in the fields involving human-computer interaction, entertainment and cosmetology. Moreover, it would assist in more critical fields like surveillance, forensic, etc. [1]. Despite the benefits this classification can provide, the ability to automatically classify age and gender with accuracy and reliability from images of faces is a long way from meeting the necessities of enterprise applications.

Introductory methods involved the usage of statistical models and features designed by experts for classification of age and gender [2–4] the achieved good scores on the dataset which contained images taken in control environment, i.e. noise free images with relatively less changing background. But their performance proved to be below expectations for "in the wild" images like present OIU-Adience benchmark dataset [5] which we will use for training and validation of our approach. Recent methods that have used Convolutional Neural Network to classify age and gender [6, 7] have been able to perform better on in the wild images but they still suffer from problems like having low accuracy for age classification or low classification speed because of increasing depth in the latest neural networks. These problems make them unsuitable for commercial real-world applications.

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In this paper, we attempt to improve on the convolution neural network techniques and cover-up for the main disadvantages faced by them, i.e. low accuracy on age classification and slow speed. Our main contribution through the proposed method is to provide a method and a model which is accurate, efficient and generalizes well, all while requiring low resources for training and easy to fine-tune for other more specific age and gender classification.

2 Related Works

Before proceeding towards describing our proposed method, we will briefly review the literature and previously used methods for age and gender classification and also provide an overview of the other related topics.

2.1 Age and Gender Classification

Now, we will briefly review the previous methods that have been proposed before and work related to our methodology, we will also briefly review literature related to the task. The early methods are based on controlled imaging environments and using manual and handcrafted features of the face. There were very few studies which focused on age and gender classification in the unconstrained real-world environments. In [8], the authors developed an age estimation method that helped determine the ratios of facial features among various dimensions using the geometric features. This method had drawbacks and was not successful in properly distinguishing the junior and senior adults while it worked well enough for infants and adults.

In [9], the authors used both the texture and geometric features for the task of prediction, using an active appearance model. Thus, this method doesn't prove to be suitable for constrained conditions of imaging as they have a lot of variations. In [4], the authors leveraged manually designed features for this task and various other works as well [10, 11]. In [12], Dileep et al. proposed a convolutional neural network and an approach 3-sigma based on control limits for classifying a person's age into various classes. Most of the approaches discussed here work only on images taken in controlled environment and is unable to achieve decent enough results on the images taken in uncontrolled environment which are often encountered in real-world and practical applications.

2.2 Deep Convolutional Neural Network

In recent times, most of the research work for classification of age and gender involves the use of convolutional neural networks (CNNs). As CNN has good feature extraction techniques thus its has the ability to classify age and gender based on the face images [13–15]. Deep CNN has been widely adopted in recent times due to the large availability of the data and the computation capabilities required to build the CNN models. CNN models are very powerful to learn discriminative and compact features from faces if the amount of data available is sufficient enough. Real-world face images classification model for age was developed by [7], composed of both convolutional and fully connected dense layer which are three and two in quantity. The issues of misalignment in the unconstrained images were handled using oversampling and centre-crop methods. In [16], the authors developed an multitask CNN system which was able to learn complex structures and weights to perform classification on age, ethnicity and gender.

Qawaqneh et al. [17] proposed a deep VGG-Face pre-trained CNN methodology for age estimation tasks. CNN models trained for this purpose have eight convolutional layers with three fully connected dense layers. In [6], the authors proposed a residual network of the residual network (RoR) for the task of age and gender estimation. In [47], the authors proposed an end-to-end multitask learning framework which solved the task of age estimation and gender recognition using a single CNN. Ranjan et al. [18] developed a CNN for classification of age using a single image of the face. This solution used a face alignment preprocessing before feeding the images to CNN. The focal loss function was used in CNN models developed by authors in [19]. In [20], the authors performed classification using hybrid CNN structure, as it used CNN to extract features but extreme learning machines to perform classification. Similarly authors in [21] also used CNN and an extreme learning machine (ELM) and this model showed improved performance. In this research work mentioned in Sects. 2.1 and 2.2, only a few experiments have been carried out in the unconstrained imaging conditions while some of these work well on images taken in controlled environment. However, the image in uncontrollable conditions is also known as in-the-wild environment is still a challenge to classify them due to variations in lighting, alignment, viewpoint, etc. This requires an effective and robust method so that the application of these models can make largely possible in the real-world environment. Here, we address these various issues and developed a CNN-based framework which is more effective and generalize for these conditions.

3 Methodology

In this section, we will discuss the methodology and describe the architecture of the proposed method's model, the training technique and other various aspects. The motivation behind the decisions is taken in the process. The methodology primarily consists of using efficientnet architecture as base on your convolutional neural network and adjusting it to the domain by iterating on a large face dataset and fine-tuning for the OIU-Adience dataset as shown in Fig. 1 which shows the pipeline for training the proposed method. It includes making changes to VGGFace2 dataset followed by domain change of neural networks and fine-tuning for the task at hand.