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Research Article

Smart Attendance System for Covid-19

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Abstract: Due to the breakdown of COVID-19 pandemic also known as Serious Acute Respiratory Syndrome Corona virus-2 is an infectious disease that is released from an infected sick person. This spreads quickly through close contact with anyone infected. Institutions suffer a great deal from practically closed globally if the current situation is not going to change. Deep Learning has proven its effectiveness in recognition and classification through image processing. The research study uses deep learning techniques in distinguishing facial recognition and recognize if the person is having issues in the body temperature , respiration and pulse rate or not. The dataset collected and achieved an accuracy rate of 96% as to the performance of the trained model. The system develops a Raspberry Pi-based real-time face- patient monitoring and recognition that alarms and captures the facial image if the person detected and send the location to the nearly hospital. This study is beneficial in combating the spread of the virus and avoiding contact with the virus.

Keywords: facial recognition; Raspberry pi; sensors; location**;** Rate;

1. Introduction

Face plays an important role in social communication. Face biometric itself is used in many applications like security, forensic and other commercial applications. Similarly facial expressions are the fastest means of communication, while conveying any type of information. In 1978, Ekman and Frisen reported that, Happy, Sad, Anger, Fear, Disgust and Surprise are the six basic expressions which are readily recognized across very different cultures. A system designed for analyzing facial actions automatically through a human computer interaction, is called Automatic Facial Expression Recognition System (AFERS) (Yu, P., 2020).

The robust AFER system can be applied in many areas of science such as emotion detection, clinical psychology and pain assessment. There are three major steps in an AFERS; 1. To detect the face from the given input image or video, 2. To extract the facial features like eyes, nose, mouth from the detected face and 3. To classify the facial expressions into different classes like Happy, Angry, Sad, Fear, Disgust, and Surprise. Face detection is a special case of object detection. In the proposed system, face detection is implemented using skin color detection and segmentation. Also it involves lighting compensation algorithm and morphological operations to retain the face from the input image

(Chavez, S., 2020) to extract the facial features, Active Appearance Model i.e. AAM method is used. Finally, the expressions are recognized as Happy, Sad, Anger, Fear, Disgust, and Surprise, initially by using simple Euclidean Distance method and then by training the Artificial Neuro-Fuzzy Inference System (ANFIS). Considering it as a pattern, the face is a challenging object to detect and recognize. The face anatomy is rigid enough so that all faces are similar in structure, yet we are very much different from each other. In addition to individual variations and the racial variations, there are the facial expressions, which allow an individual to change his or her appearance significantly.

1.1 Artificial Intelligence

Artificial intelligence (AI) is intelligence demonstrated by machines, unlike the natural intelligence displayed by humans and animals, which involves consciousness and emotionality. The distinction between the former and the latter categories is often revealed by the acronym chosen. 'Strong' AI is usually labelled as AGI (Artificial General Intelligence) while attempts to emulate 'natural' intelligence have been called ABI (Artificial Biological Intelligence). Leading AI textbooks define the field as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals. Colloquially, the term "artificial intelligence" is often used to describe machines (or computers) that mimic "cognitive" functions that humans associate with the human mind, such as "learning" and "problem solving"(World Health Organization. 2020)

1.2 History of Artificial Intelligence

Artificial Intelligence was first proposed by John McCarthy in 1956 in his first academic conference on the subject. The idea of machines operating like human beings began to be the center of scientist's mind and whether if it is possible to make machines have the same ability to think and learn by itself was introduced by the mathematician Alan Turing. Alan Turing was able to put his hypotheses and questions into actions by testing whether "machines can think"? After series of testing it turns out that it is possible to enable machines to think and learn just like humans. Turing Test uses the pragmatic approach to be able to identify if machines can respond as humans.

1.3 Image Processing

The term digital image refers to processing of a two dimensional picture by a digital computer. In a broader context, it implies digital processing of any two dimensional data. A digital image is an array of real or complex numbers represented by a finite number of bits. An image given in the form of a transparency, slide, photograph or an X-ray is first digitized and stored as a matrix of binary digits in computer memory. This digitized image can then be processed and/or displayed on a high-resolution television monitor. For display, the image is stored in a rapid-access buffer memory, which refreshes the monitor at a rate of 25 frames per second to produce a visually continuous display (Bai, Y.,2020).

1.3.1 Image Processor

An image processor does the functions of image acquisition, storage, pre-processing, segmentation, representation, recognition and interpretation and finally displays or records the resulting image. The following block diagram gives the fundamental sequence involved in an image processing system. As detailed in the diagram, the first step in the process is image acquisition by an imaging sensor in conjunction with a digitizer to digitize the image. The next step is the preprocessing step where the image is improved being fed as an input to the other processes. Preprocessing typically deals with enhancing, removing noise, isolating regions, etc.

1.3.2 Image Processing Techniques

Image compression and decompression reduce the data content necessary to describe the image. Most of the images contain lot of redundant information, compression removes all the redundancies. Because of the compression the size is reduced, so efficiently stored or transported. The compressed image is decompressed when displayed. Lossless compression preserves the exact data in the original image, but Lossy compression does not represent the original image but provide excellent compression.

Image enhancement operations improve the qualities of an image like improving the image's contrast and brightness characteristics, reducing its noise content, or sharpen the details. This just enhances the image and reveals the same information in more understandable image. It does not add any information to it.

Image restoration like enhancement improves the qualities of image but all the operations are mainly based on known, measured, or degradations of the original image. Image restorations are used to restore images with problems such as geometric distortion, improper focus, repetitive noise, and camera motion. It is used to correct images for known degradations.

Image analysis operations produce numerical or graphical information based on characteristics of the original image. They break into objects and then classify them. They depend on the image statistics. Common operations are extraction and description of scene and image features, automated measurements, and object classification. Image analyze are mainly used in machine vision applications.

1.4 Image Processing Fundamentals

Many of the techniques of digital image processing, or digital picture processing as it often was called, were developed in the 1960s at the Jet Propulsion Laboratory, Massachusetts Institute of Technology, Bell Laboratories, University of Maryland, and a few other research facilities, with application to satellite imagery, wire-photo standards-conversion, medical imaging, videophone, character recognition, and photograph enhancement. The cost of processing was fairly high, however, with the computing equipment of that era. That changed in the 1970s, when digital image processing proliferated as cheaper computers and dedicated hardware became available. Images then could be processed in real time, for some dedicated problems such as television standards conversion. As general-purpose computers became faster, they started to take over the role of dedicated

hardware for all but the most specialized and computer-intensive operations. In particular, digital image processing is the only practical technology for:

1. Classification
2. Feature extraction
3. Pattern recognition
4. Projection
5. Multi-scale signal analysis

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too. Digital image processing refers processing of the image in digital form. Modern cameras may directly take the image in digital form but generally images are originated in optical form. They are captured by video cameras and digitalized (Centers for Disease Control and Prevention2020).

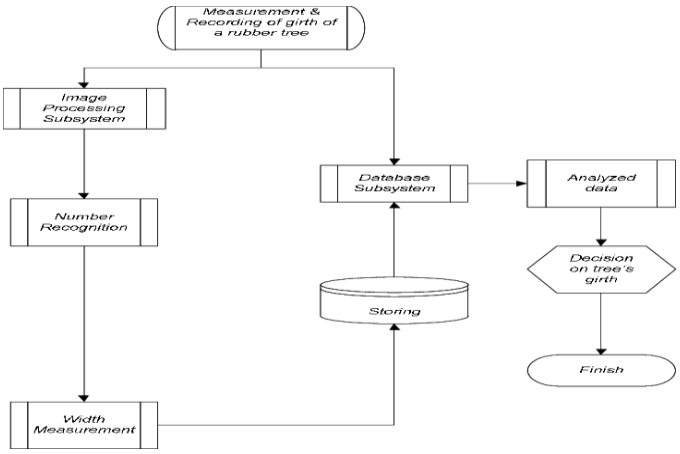

Figure 1. Basic Image Processing architecture

1.5 Raspberry Pi

It is a small sized computer with low cost. It can be used along with monitor or TV. An SD card is used to act as a hard drive for the Pi and can be operated by powering the Raspberry PI using a USB.Inorder to record the attendance a server is needed and Raspberry Pi can be used as a server as it is drawing extremely low power and produces less noise. This hardware receives the information from an handheld device and makes an excel sheet of its own and enters the data. It is basically a microcontroller that acts just as a computer.

1.6 Advantages

The processing of images is faster and more cost-effective. One needs less time for processing, as well as less film and other photographing equipment. Copying a digital image is easy, and the quality of the image stays good unless it is compressed. For instance, saving an image as jpg format compresses the image. By resaving the image as jpg format, the compressed image will be recompressed, and the quality of the image will get worse with every saving. Fixing and retouching of images has become easier. In new Photoshop 7, it is possible to smoother face wrinkles with a new Healing Brush Tool in a couple of seconds. The expensive reproduction (compared with restoring the image with a repro camera) is faster and cheaper. By changing the image format and resolution, the image can be used in a number of media.

1.7 Applications of Image Processing

Each individual platforms and programming languages will have their own characteristics which would be unique (Sim, S. 2020). Like this, Image Processing also have certain applications that induce the growth of this particular field . Some of the key applications of Image Processing are described briefly below

1.7.1 Image Sharpening and restoration: Image sharpening and restoration refers here to process images that have been captured from the modern camera to make them a better image or to manipulate those images in way to achieve desired result. It refers to do what Photoshop usually does. This includes Zooming, blurring, sharpening, gray scale to colour conversion, detecting edges and vice versa, Image retrieval and Image recognition.

1.7.2 Medical field- UV imaging: In the field of remote sensing, the area of the earth is scanned by a satellite or from a very high ground and then it is analyzed to obtain information about it. One particular application of digital image processing in the field of remote sensing is to detect infrastructure damages caused by an earthquake.As it takes longer time to grasp damage, even if serious damages are focused on. Since the area effected by the earthquake is sometimes so wide, that it not possible to examine it with human eye in order to estimate damages. Even if it is , then it is very hectic and time consuming procedure. So a solution to this is found in digital image processing. An image of the effected area is captured from the above ground and then it is analysed to detect the various types of damage done by the earthquake.

1.7.3 Pattern recognition: Pattern recognition involves study from image processing and from various other fields that includes machine learning (a branch of artificial intelligence). In pattern recognition, image processing is used for identifying the objects in an images and then machine learning is used to train the system for the change in pattern. Pattern recognition is used in computer aided diagnosis, recognition of handwriting, recognition of images etc.

1.7.4 Transmission and encoding: The very first image that has been transmitted over the wire was from London to New York via a submarine cable. Now just imagine, that today we are able to see live video feed, or live cctv footage from one continent to another with just a delay of seconds. It means that a lot of work has been done in this field too. This field does not only focus on transmission, but also on encoding. Many different formats have been developed for high or low bandwidth to encode photos and then stream it over the internet or etc.

2. Related Works

From the various researches, observed that there are some relevant works which similar to the current proposal whose ideas, works and drawbacks are listed below:

(YU, P., ZHU, J., ZHANG, Z., & HAN, Y. (2020)) With the recent COVID-19 pandemic, healthcare systems all over the world are struggling to manage the massive increase in emergency department (ED) visits. This has put an enormous demand on medical professionals. Increased wait times in the ED increases the risk of infection transmission. In this work we present an open-source, low cost, off-body system to assist in the automatic triage of patients in the ED based on widely available hardware. The system initially focuses on two symptoms of the infection - fever and cyanosis. The use of visible and far-infrared cameras allows for rapid assessment at a 1m distance, thus reducing the load on medical staff and lowering the risk of spreading the infection within hospitals. Its utility can be extended to a general clinical setting in non-emergency times as well to reduce wait time, channel the time and effort of healthcare professionals to more critical tasks and also prioritize severe cases.[8]

FENG, S., SHEN, C., XIA, N., SONG, W., FAN, M., & COWLING, B. J. ((2020)) Continuous Physiological parameter monitoring is essential for elderly and ill patients. There is a need for a Web-based Patient health monitoring system, when the patient is not in the Hospital. Such a system will enable the doctors to monitor the physiological parameters online and take necessary action in emergency. In this paper, a prototype of basic physiological parameter monitoring system based on Arduino and Raspberry Pi microcontroller boards is implemented. Various basic physiological parameters such as blood pressure, heartbeat, oxygen saturation in Blood (SPO2), body temperature and fall detection are measured using relevant sensors and sent to the Arduino microcontroller board for further processing. The computed parameters are then sent to a Raspberry Pi based Web server for display on the web page. ZigBee is used for communication between Arduino and Raspberry Pi. The necessary software is developed using Arduino IDE and Python language[9].

(Chavez, S., Long, B., Koyfman)As a result of the difficulties brought by COVID-19 and its associated lockdowns, many individuals and companies have turned to robots in order to overcome the challenges of the pandemic. Compared with traditional human labor, robotic and autonomous systems have advantages such as an intrinsic immunity to the virus and an inability for human-robot-human spread of any disease-causing pathogens, though there are still many technical hurdles for the robotics industry to overcome. This survey comprehensively

reviews over 200 reports covering robotic systems which have emerged or have been repurposed during the past several months, to provide insights to both academia and industry. In each chapter, we cover both the advantages and the challenges for each robot, finding that robotics systems are overall apt solutions for dealing with many of the problems brought on by COVID-19, including: diagnosis, screening, disinfection, surgery, telehealth, care, logistics, manufacturing and broader interpersonal problems unique to the lockdowns of the pandemic. By discussing the potential new robot capabilities and fields they applied to, we expect the robotics industry to take a leap forward due to this unexpected pandemic.

Hercules is designed with autonomous navigation capability and a variety of hardware technologies including a Drive-by-Wire (DBW) chassis, an Industrial Personal Computer (IPC) and sensors. A Vehicle Control Unit (VCU) responds to critical safety signals including stop signs and other road signals, explains Liu. Sensors are also installed in the bumper and tires to avoid collisions on the road. Hercules knows how to get to its destination through the use of a software platform in the cloud. "The map server stores the pre-built map for the traversed environments," explains Liu. "A scheduling server performs the task allocations and collects the status of every registered running vehicle. It also plays the role of accessing the map data for routing, transmitting sensor data into the map server, recording the key information into the log server, and replaying the data recorded for a good trace-back." This information keeps Hercules and others safe while it navigates. Liu's autonomous vehicle is already navigating busy urban streets in various cities across China and delivering fresh vegetables to residential areas, boxed meals from restaurants and spray disinfectants to hospitals. "We have been serving over 1,000 km during this period by delivering vegetables to confined areas without people-to-people contact," says Liu. "We also help deliver food to check points and help with disinfection for hospital areas."

3. EXISTING SYSTEM AND ISSUES

We can classify the recognition algorithm into two main approaches: 1) Geometric: This approach mainly deals with the spatial correlation uniting the profile (i.e. face) features, also we can simply that dimensional layout of the facial attributes. Some of the main geometrical attributes of a human face are nose, eyes and the mouth. Based on these attributes firstly the face is categorized and then based on these attributes respective spatial intervals and the respective associated gradients are estimated, thereby advancing the process of face recognition. Photometric stereo: It is a methodology of computer vision technology which mainly recuperates the structure of an underlying object from the images that were shot in varying circumstances that were affected by the lighting environment. An arrangement of the surface standards shown by the slope chart that finally elucidate the retrieved entity's configuration. Localization: After the process of classification, the bounding box is thus used to localize the searched human face from the results of the trained neural network. There are numerous attributes of face on which work has been done, some of them are: Position, scale, orientation and illumination (Jefferson, T. et al 2011).

The COVID-19 pandemic unraveled the weak points in the global supply chain for goods. Specifically, people all over the world, including those in the most advanced nations have had to go without medical supplies and personal protective equipment. Scarcity of essentials increases anxiety and uncertainty exacerbating unproductive behaviors like hoarding and price gouging. Left to market forces, such unfair practices are likely to aggravate hardships and increase the loss of lives. Thus, there is a critical need to ensure safe distribution of food and essential supplies to all citizens to sustain them through challenging times. To this end, we propose a simple, affordable and contact-less robotic system for preparing and dispensing food and survival-kits at community scale.

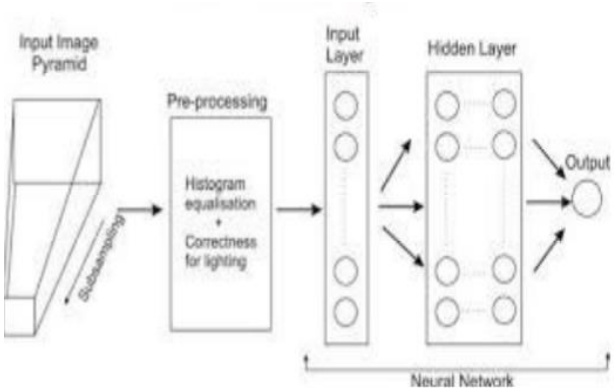

Figure 2. Block Diagram of Existing System

3.1 Challenges in Existing System

Though the existing system is good at collecting the information for Covid19. It doesn't pass the information to nearby hospital which will be available during any emergency. Like that there were various other scenarios in which some of the employees will not be concerned about the health care. Some of the worse situations are due to improper checking for the employee or student health conditions. To overcome all these worse cases we need a proper system to check the person's current health state and work according to it. The existing system doesn't inform anything about the employee to the nearby hospital, nearby health care center and family members. The most challenging one is contacting the casualty of the hospital. We have done this through a web application we can dynamically update the contents anywhere at any time.

4. PROPOSED SYSTEM

The idea behind the proposed system is to deler an effective smart health care process and make it a successful one. The development of the robot technologies in this COVID-19, there are still a lot of challenges to face. First, the level of autonomy needs to be continuously improved. For example, some robot-assisted sampling procedures can avoid close contact between the medical staff and the patients, but teleoperations are still required to finish the sampling. Therefore, if the fully autonomous procedure are wanted, a lot of components have to be integrated, such as HRI, computer vision, AI, etc. Second, the reliability needs to be guaranteed in many applications. For example, the robot needs to have superior safety features since it either directly interacts with human or works in a densely populated environment. Also, many technologies need to be refined for medical use (Jefferson, T. et al 2011).

For instance, AI and computer vision are widely used in human detection, face recognition, diagnosis, etc. Any false positive or false negative mistakes will cause great risk for the public heath. Third, sensor technologies and underlying components of the abnormal need to be improved. The motivation of this project is to monitor the patient's treatment status is to provide details of pulse rate, respiration sensor and the body temperature at any time and every single component can contribute to the overall performance.

4.1 Facial Detection Module

Some facial recognition algorithms identify faces by extracting landmarks or features from an image. For example, an algorithm may analyze the relative position, size, and/or shape of the eyes, nose, cheekbones and jaw. These features are then used to search for other images with matching features. Other algorithms normalize a gallery of face images and then compress the face data, only saving the data in the image that is useful for face detection. A probe image is then compared with the face data. One of the earliest successful systems is based on template matching techniques applied to a set of salient facial features, providing a sort of compressed face representation.

4.2 Sensor module

ECG basically detects the electrical activity of heart. It also determines rate, rhythm and conductivity of heart. We have proposed to calculate the heart rate using the same module using suitable algorithm to calculate heart rate. Core Body Temperature of a pet animal indicates the body temperature of it which is also known as rectal temperature. The temperature range is dog's body temperature is from 37.9 to 39.9 degree Celsius. If the value of body temperature does not lie in this range it denotes abnormality. To measure the temperature, we have proposed to use LM35 temperature sensor which operates over a range of -55 to +125 degree Celsius.

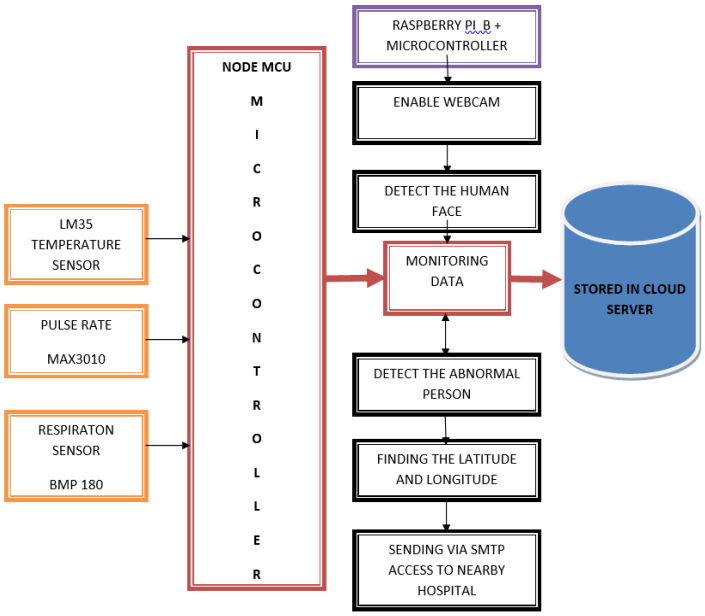

Figure.3. Architecture of proposed system

4.3 Cloud server with sensors

IOT employee monitoring has 3 sensors. The first one is a temperature sensor, the second is the Heartbeat sensor and the third one is respiration sensor. This project is very useful since the doctor can monitor patient health parameters just by visiting a website or URL. And nowadays many IOT apps are also being developed. So now the doctor or family members can monitor or track the patient's health through the IOT API Server.To operate IOT based health monitoring system project, you need a WiFi connection. The microcontroller or the NodeMCU board connects to the Wi-Fi network using a Wi-Fi module. This project will not work without a working WiFi network. You can create a WiFi zone using a WiFi module or you can even create a WiFi zone using Hotspot on your smartphone. The NodeMCU board continuously reads input from these 6 senses. Then it sends this data to the cloud by sending this data to a particular URL/IP address. Then this action of sending data to IP is repeated after a particular interval of time.

4.4 Email Module

When the person is confirmed with the certain with illness from the raise in the temperature then the automated email will be sent to the corresponding hospital with the attachment of his or her location. This helps the hospital to track the person's location or else if the person is good with the normal body temperature then his or her in and out time will be detected in the company or institution with the captured image from the web camera.The RTO office officials will register the user credentials in this application system.

5. Conclusion

Human beings perform face recognition automatically every day and practically with no effort. Although it sounds like a very simple task for us, it has proven to be a complex task for a computer, as it has many variables that can impair the accuracy of the methods, for example: illumination variation, low resolution, occlusion, amongst other. In face recognition is basically the task of recognizing a person based on its facial image. Note that face recognition is different of face detection.Face Detection: it has the objective of finding the faces (location and size) in an image and probably extract them to be used by the face recognition algorithm.Face Recognition: with the facial images already extracted, cropped, resized and usually converted to grayscale, the face recognition algorithm is responsible for finding characteristics which best describe the image.In this project, we developed a device that converts an image's text to speech. The basic framework is an embedded system that captures an image, extracts only the region of interest (i.e. region of the image that contains text) and converts that text to speech. It is implemented using a Raspberry Pi and a Raspberry Pi camera.

References

1. Bai, Y., Yao, L., Wei, T., Tian, F., Jin, D. Y., Chen, L., & Wang, M. (2020). *Presumed Asymptomatic Carrier Transmission of COVID-19. JAMA, 323(14), 1406–1407. Advance online publication. https://doi.org/10.1001/jama.2020.2565*
2. *Centers for Disease Control and Prevention. Interim Infection Prevention and Control Recommendations for Patients with Suspected or Confirmed Coronavirus Disease 2019 (COVID-19) in Healthcare Settings.*
3. Chavez, S., Long, B., Koyfman, A. & Liang, S. Y. (2020), *Coronavirus Disease (COVID-19): A primer for emergency physicians. Am J Emerg Med, https://doi:10.1016/j.ajem.2020.03.036.*
4. Cowling, B. J. (2009) *et al. Facemasks and hand hygiene to prevent influenza transmission in households: a cluster randomized trial. Ann Intern Med 151, 437-446, https://doi:10.7326/0003-4819-151-7-200910060- 00142.*
5. Ezhilarasi, G.Dilip, T.P.Latchoumi, K.Balamurugan* (2020), *UIP—A Smart Web Application to Manage Network Environments, Advances in Intelligent systems and computing book series, https://doi.org/10.1007/978-981-15-1480-7_8, 97-108.*
6. Jefferson, T. (2011), *et al. Physical interventions to interrupt or reduce the spread of respiratory viruses. Cochrane Database Syst Rev, CD006207, https://doi:10.1002/14651858.CD006207.pub4* .
7. Krizhevsky, I. Sutskever, and G. E. Hinton*, "Imagenet classification with deep convolutional neural networks," in Advances in Neural Information Processing Systems 25, F. Pereira, C. J. C. Burges, L. Bottou, and K. Q. Weinberger, Eds. Curran Associates, Inc., 2012, pp. 1097–1105.*
8. *Korea Centers for Disease Control and Prevention. Infection Prevention and Control Recommendations for Patients with Suspected or Confirmed Coronavirus Disease 2019 (COVID-19) in Healthcare Settings [in Korean].* 2020
9. Latchoumi T. P, K. Balamurugan, K. Dinesh and T. P. Ezhilarasi, (2019). *Particle swarm optimization approach for water-jet cavitation preening. Measurement, Elsevier, 141,184-189.*
10. Latchoumi T. P, T. P. Ezhilarasi, K. Balamurugan (2019), *Bio-inspired Weighed Quantum Particle Swarm Optimization and Smooth Support Vector Machine ensembles for identification of abnormalities in medical data. SN Applied Sciences (WoS), 1137, 1-12, DOI: 10.1007/s42452-019-1179-8.*
11. Latchoumi, T. P., Reddy, M. S., & Balamurugan (2020), *K. Applied Machine Learning Predictive Analytics to SQL Injection Attack Detection and Prevention. European Journal of Molecular & Clinical Medicine, 7(02), 3543-3553*
12. Sim, S. W., Moey, K. S. & Tan, N. C. *The use of facemasks to prevent respiratory infection: a literature review in the context of the Health Belief Model. Singapore Med J 55, 160-167*
13. Pruthviraju G, K.Balamurugan*, T.P.Latchoumi, Ramakrishna M (2021), *A Cluster-Profile Comparative Study on Machining AlSi7/63% of SiC hybrid composite using Agglomerative Hierarchical Clustering and K-Means, Silicon, 13, 961–972, DOI: 10.1007/s12633-020-00447-9, Springer.*
14. Simonyan and A. Zisserman (2014), *"Very deep convolutional networks for large-scale image recognition," CoRR, vol. abs/1409.1556.*
15. Tracht, S. M., Del Valle, S. Y. & Hyman, J. M. (2010). *Mathematical modeling of the effectiveness of facemasks in reducing the spread of novel influenza A (H1N1). PLoS One 5,https://doi:10.1371/journal.pone.0009018*.
16. Vijay Vasanth A,Latchoumi T.P, Balamurugan Karnan,Yookesh T.L (2020*) Improving the Energy Efficiency in MANET using Learning-based Routing, Revue d'Intelligence Artificielle, 34(3), pp 337-343.*
17. Venkata Pavan M,Balamurugan Karnan*, Latchoumi T.P (2021), *PLA-Cu reinforced composite filament: Preparation and flexural property printed at different machining conditions, Advanced Composite Materials, https://doi.org/10.1080/09243046.2021.1918608*
18. World Health Organization. Coronavirus disease 2019 (COVID-19) Situation Report– 142, 2020, [cited 10 June 2020], https://www.who.int/docs/default-
19. Yu, P., Zhu, J., Zhang, Z., & Han, Y. (2020). *A Familial Cluster of Infection Associated With the 2019 Novel Coronavirus Indicating Possible Person-to-Person Transmission During the Incubation Period. The Journal of infectious diseases, 221(11), 1757–1761. https://doi.org/10.1093/infdis/jiaa077.*