Covid-19 Social Distance Identification and Suspicious Activity Detection in Local and Remote Environments

Mahanthesha U[#1], H S Mohana[*2]

[#]*Assistant Professor, Department of ECE, GSSS Institute of Engineering & Technology for Women, Mysuru, Karnataka, INDIA*

**Principal, NAVKIS College of Engineering, Hassan, Karnataka, INDIA*

Abstract

The use of video surveillance to identify suspicious actions in public movement areas has drew the attention of a growing number of current technologies. Offline video automated processing prototypes have been used to monitor different types of events, including riots and forensics inspections. Nonetheless, relatively little progress has been made in terms of event recognition. In this paper, we propose a structure for processing original video received from a stationary colour camera located in a suitable region and drawing real-time judgments about the observed tasks. First, utilising a blob matching methodology, this proposed structure obtains 2D and 3-D object level inputs by recognising, detecting, and tracing persons in the scenario. Using object and inter-object motion characteristics, based on the derived spatial temporal features of recognised blobs and behaviours.

This Artificial Intelligence and Machine Learning techniques are used in conjunction with a sophisticated experimental MATLAB tool to watch and recognise all single and group human actions. Machine learning algorithms are utilised in this article to identify and monitor social separation between one or more people's movements in public locations, and these observations may be made using CCTV footage. From this observation, the system will square mark as green for respecting social distance norms, and if two or more people are close together, the system will square mark as red, indicating that the people moving in that location are breaking the social distance regulations.

Keywords: Loitering, behavior recognition, Social distancing object tracking, fainting, blob matching, fighting, meeting, and occlusion

---

I. INTRODUCTION

Currently, police officers, security officers, and staff employees rely on video observation prototypes to help them with their daily tasks. This application may be seen in large public circulation areas across the world, such as bus stops, train stations, airports, and metro stations. These real-time systems, on the other hand, are labor-intensive, and the display videos of human routine activities monitoring find it difficult to pay attention to random events [1][2]. Despite the fact that automated video surveillance systems exist, they have mostly been used for typical offline video analogy after an occurrence, particularly in forensics and riot surveillance situations. These security surveillance tools are currently of extremely limited use for real-time notifications.

Based on low camera quality and poor lighting conditions, computerised facial identification and recognition was not very useful in recent samples from a foreign country [3]. An automated security surveillance and observation system's goal is to draw the attention of a single or group of human action monitors to an instance of a user-defined suspicious attribute as soon as it occurs. The development of a completely automated behaviour identification system faces two distinct problems. First, the items of interest, which in this case are persons and their luggage, must be categorised, and then they must be monitored for a predetermined period of time. Second, a reliable method of narrating behaviours must be implemented. This becomes a serious challenge, especially for highly complicated actions with several permutations, such as meeting, fighting, and so on. It is undeniably difficult to describe the system in the majority of circumstances.

One of the achievements of this study is the development of a mathematical method for the identification of the most risky or suspicious human behaviours based on abstract explanations presented by Velastin and Fuentes[4]. These are all directly tied to societal benefits from adequate public transportation security surveillance, and isolated regions also deal with issues like abandoned and loitering, luggage theft, fainting, meetings, and fights. High-level human movement parameters, such as speed, velocity, and particular distance between the objects in the scenario, are incorporated into this newly suggested technique. These semantic entities are defined in 3-D rather than 2-D. We should also mention that crowd behaviour is included in the scope of this text. A powerful experimental MATLAB application uses artificial intelligence and machine learning algorithms to examine all of the behaviours of single and group human activities detection and recognition.

People are not observing social distance and wearing masks in public areas as a result of the global Covid-19 outbreak. For the objective of social service, an algorithm was created and implemented. Which principle was used to construct the Python Open CV Tool in order to improve performance and provide the necessary social distancing alarm system? The coding portion of this project is highly user friendly with this Python Open CV.

II. RELATED WORKS

To demonstrate the effectiveness of this unique strategy, several sorts of human actions linked to security in public transportation areas have been identified. Stolen and abandoned objects, loitering, fainting, and fighting are some instances. Using real-time data sets as input to the machine learning system, the system's outcomes illustrate the approach's good performance and cheap computational complexity.

The major focus of this research is on automatically detecting and indicating sceptical behaviour in public movements or transportation systems. Meeting, lingering [11], abandoned semantic entities [12][14], and getting into a brawl [14][15] are some examples. The many sorts of conduct might occur over a long period of time. One key challenge in this discipline is that the bulk of published studies focus on identifying a specific type of behaviour rather than offering a broad or general framework. For example, low-level background subtraction algorithms are frequently used in "abandoned baggage identification" [1] [9]. This approach is useful for detecting stationary things, but it isn't recommended for other sorts of human behaviour such as fighting or loitering. Furthermore, most studies that describe a generic behaviour detection and identification framework simply give high-level layered framework descriptions without providing any particular technique for implementation. Hidden Markov Models (HMMs) [14] and machine learning temporal random forests methods [8] are examples of classifiers that need training.

Every classifier contains flaws as well as distinguishing traits. HMMs, for example, are unable to record sub events due to their intrinsic tendencies [9]. Researchers have used detection and identification based on semantics as another option for such learning strategies. This feature offers more relevant descriptions of typical happenings, which helps people grasp them better. All events can have both manual [18] and trainable [20] interpretations thanks to semantic-based recognition.

III. SYSTEM ARCHITECTURE

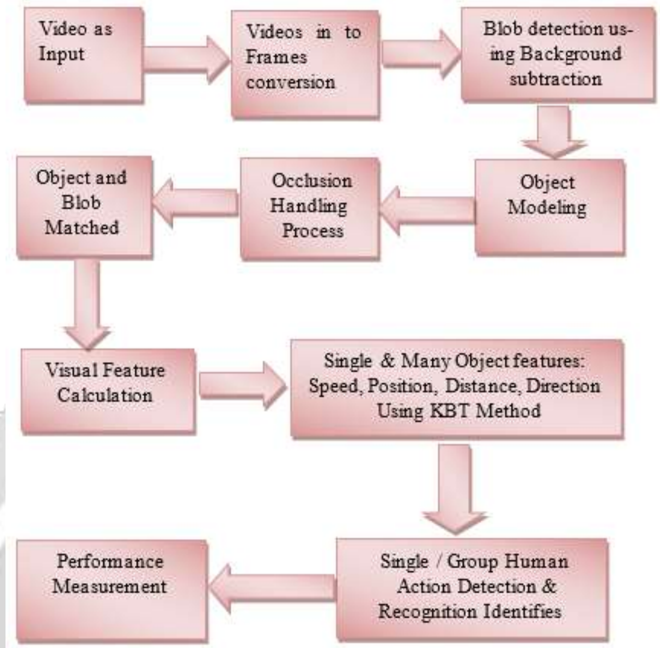

Fig.1. The system architecture of the proposed algorithm

Figure 1 depicts the suggested system design. The occlusion handling step is used to identify and recognise the main activity. The following are examples of common localization and target representation algorithms:

• Blob Tracking: This algorithm specifies the segmentation of an object's interior (for example, blob detection, optical flow / block-based correlation).

• Kernel Based Tracking (KBT): KBT, also known as mean-shift tracking, is an iterative localization process that relies on the maximising of all actions' similarity measures.

• Contour Tracking: CT detection (e.g. Condensation algorithm/active contours) is utilised to determine the object boundary.

• Visual Feature Matching (VFM): VFM techniques are used to match the visual actions of individual or group human activities.

IV. FEATURES MEASUREMENTS

After identifying the semantic events of interest in the supplied input video, the 2-D and 3-D characteristics of these objects' movement activities are computed, and the prior record is created. The observed items are again classified based on the entries made in this record file to determine whether the activities are alive (people) or inanimate (things). This is a crucial stage in classifying items as living or inanimate. Figure 2 depicts the traditional Machine Learning and Deep Learning methodologies for detecting and recognising single or group human actions.

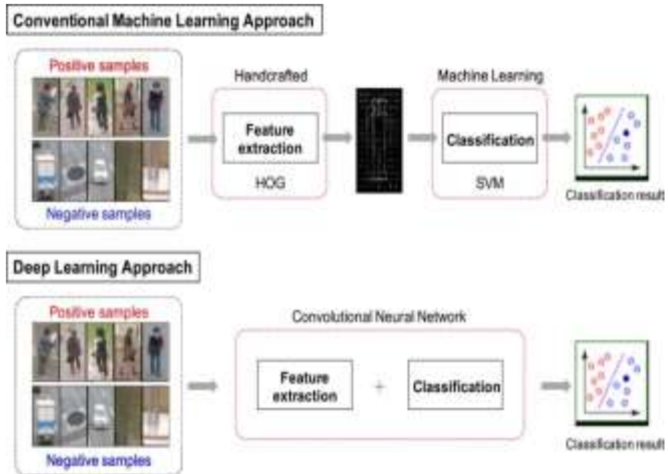

Fig.2. The conventional Machine Learning and Deep Learning approaches for single or group human action detection and recognitions

The input movies are separated into a number of frames, with a minimum of 15 frames for 1 second films. To identify irregular blobs for 2D objects from CCTV recordings, all of the frames were processed using random forest supervised machine learning methods. To obtain the required result, the irregular human behaviour is collected at higher frame rates and monitored. In this article, historic human action sequences are characterised as alive or inanimate blobs acts using a mix of single and group characteristics items.

These feature extraction approaches are also utilised to determine the social separation between one or more people's movements in public locations, which may be seen using CCTV footage.

V. BEHAVIOUR SYMANTICS

As input to the system, the extracted actions characteristics are used to semantically define and recognise the activities in the video. Every unit time, the historical record that records the characteristics of a certain behavioural object and the semantic events pair is updated. A set of particular defined requirements for each activity of interest is tested based on the contents of the record (once for every second, in this paper). That behaviour is identified if the particular conditions in the current problem description are met. Individually, the behaviours of interest are examined in depth below, along with suitable examples.

The following are the semantics of human behaviour that have been tested: • Abandoned and Stolen Objects:
• Fainting • Loitering • Covid-19 Social distancing • Fighting • Meeting and Walking Together

Figure 3 depicts the several phases of human behaviour semantics such as Motion, Action, Activity, and Behavior based on the degree of semantics and time frame.

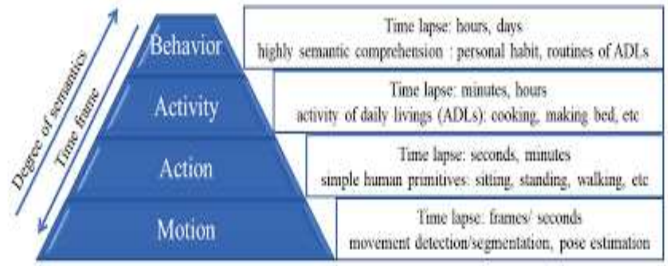

Fig.3. Illustration of Human Behaviors Semantics

VI. EXPERIMENTAL RESULTS

The following are the findings of experiments utilising machine learning algorithms to detect and recognise suspicious activities in real time. Figure 4 shows the aspect ratio of the blob in relation to faint detection from CCTV input footage.

Fig.4. Illustration of blob's aspect ratio related to faint detection

Figure 5 depicts a conference where security questionable human behaviours of numerous people are discovered using AI and machine learning techniques.

Fig.5. Snapshots of the experimental results of meet and fight on standard input data sets

Figure 6 depicts abandoned activities such as steeling in public areas, walking together, and other human acts.

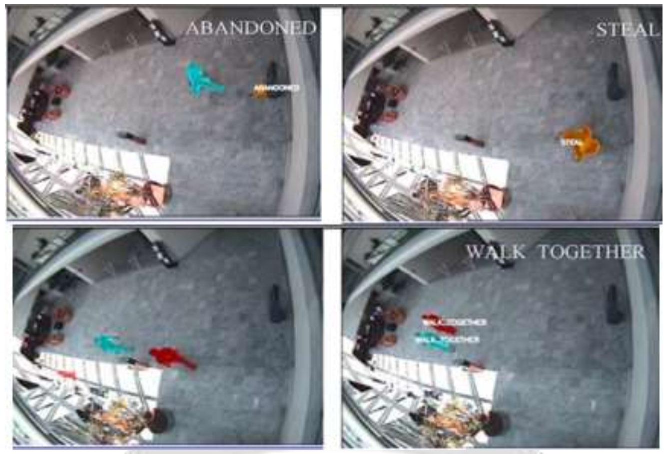

Fig. 6. Snapshots of the system results of abandoned steal and walk together.

Figures 7 and 8 show the group human normal activity detection and recognition utilising the KTL method, as well as edge detection of all people, corner detections, KTL detection sites, and an output statement like "The video exhibits normal behaviour."

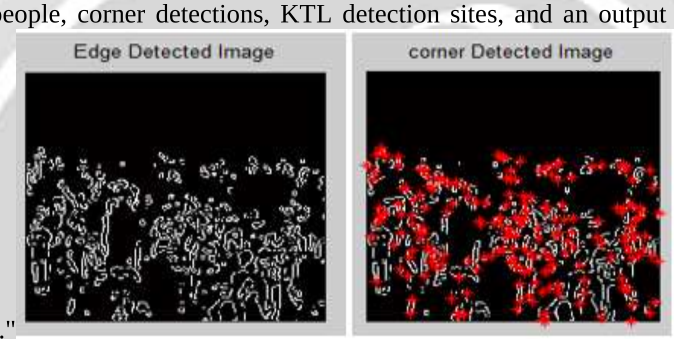

Fig.7. Edge detection and corner detection of Group activity

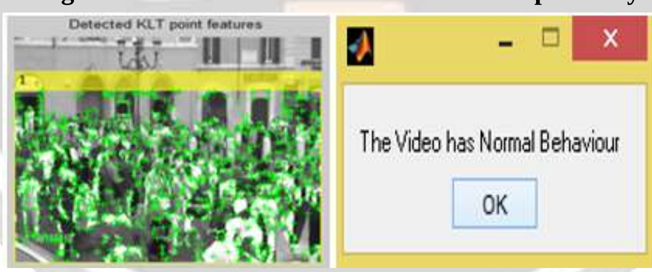

Fig.8. Detection KLT Point Features and the Normal behavior video output

These supervised machine learning approaches are used to identify and monitor social separation between one or more people's movements in public spaces, and these observations may be made using CCTV footage. From this observation, the system will square mark as green for obeying social distance norms, and if two or more people are close together, the system will square mark as red and identify that the people moving in that location are breaching the social distance indicated in figs. 9 and 10.

Fig.9. Illustration of Covid-19 Social Distance Detection and Tracking from CCTV videos

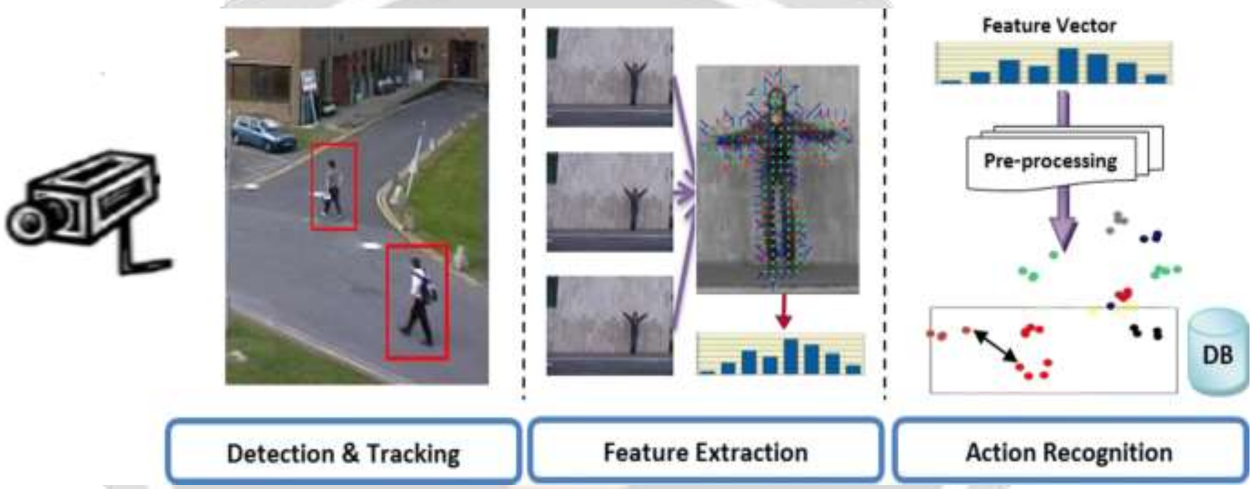

Fig.11. Representation of human motion detection and tracking from CCTV input video for social distance alert systems.

VII. CONCLUSION

This paper introduces and investigates an absolute semantics-based behaviour detection and identification system that is only dependent on object tracking. This technique is described by background segmentation, which translates the actions obtained. These human objects are studied in two dimensions, and artificial intelligence and machine learning methods are used to classify them. The performance of the 2D and 3-D human motion derived characteristics is then tested using the specified unique action.

Human single or group activities are eventually discovered by continuous monitoring utilising the appropriate AI and ML algorithms. This idea is extensively utilised in security applications, investigations, and the monitoring of suspicious activities in public transportation areas, among other things. This unique approach delivers real-time outputs performance, resilience, flexibility, and digital camera impacts of nonlinearities. This approach solves the problem of interacting with people's operators while also reducing the need for AI and machine learning training. This experiment was assessed based on several inputs such as a single or group person's detection and recognition of a variety of activities of interest.

VIII. FUTURE WORK

Novel idea data fusion approaches can be used to make future applications of real-time human action detection systems that use artificial intelligence and machine learning techniques functional. The fusion of several activities of a single person or many human actions may be discovered and recognised in this study in order to get the greatest output performance for the supplied input footage.

ACKNOWLEDGMENT

The author wishes to express his appreciation to everyone who has contributed, recommended, and coordinated raw data collecting and algorithm implementation for the publishing of this research, whether directly or indirectly.

REFERENCES

[1] Dr. H S Mohan and Mahanthesha U, “Human action Recognition using STIP Techniques”, International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-7, May 2020

[2] J. F. Allen, “Maintaining knowledge about temporal intervals,” Commun. ACM, vol. 26, no. 11, pp. 832–843, Nov. 1983.

[3] C. Fernandez, P. Baiget, X. Roca, and J. Gonzalez, “Interpretation of complex situations in a semantic-based surveillance framework,” Image Commun., vol. 23, no. 7, pp. 554–569, Aug. 2008.

[4] J. Candamo, M. Shreve, D. B. Goldgof, D. B. Sapper, and R. Kasturi, “Understanding transit scenes: A survey on human behavior-recognition algorithms,” IEEE Trans. Intell. Transp. Syst., vol. 11, no. 1, pp. 206–224, Mar. 2010.

[5] Y. Changjiang, R. Duraiswami, and L. Davis, “Fast multiple object tracking via a hierarchical particle filter,” in Proc. 10th IEEE ICCV, 2005, vol. 1, pp. 212–219.

[6] A. Loza, W. Fanglin, Y. Jie, and L. Mihaylova, “Video object tracking with differential Structural SIMilarity index,” in Proc. IEEE ICASSP, 2011, pp. 1405–1408.

[7] D. Comaniciu, V. Ramesh, and P. Meer, “Kernel-based object tracking,” IEEE Trans. Pattern Anal. Mach. Intell., vol. 25, no. 5, pp. 564–577, May 2003.

[8] V. Papadourakis and A. Argyros, “Multiple objects tracking in the presence of long-term occlusions,” Comput. Vis. Image Underst., vol. 114, no. 7, pp. 835–846, Jul. 2010.

[9] Mahanthesh U, Dr. H S Mohana “Identification of Human Facial Expression Signal Classification Using Spatial Temporal Algorithm” International Journal of Engineering Research in Electrical and Electronic Engineering (IJEREEE) Vol 2, Issue 5, May 2016

[10] NikiEfthymiou, Petros Koutras, Panagiotis, Paraskevas, Filntisis, Gerasimos Potamianos, Petros Maragos “Multi-View Fusion for Action Recognition in Child-Robot Interaction”: 978-1-4799-7061-2/18/$31.00 ©2018 IEEE.

[11] Nweke Henry Friday, Ghulam Mujtaba, Mohammed Ali Al-garadi, Uzoma Rita Alo, analysed “Deep Learning Fusion Conceptual Frameworks for Complex Human Activity Recognition Using Mobile and Wearable Sensors”: 978-1-5386-1370-2/18/$31.00 ©2018 IEEE.

[12] Van-Minh Khong, Thanh-Hai Tran, ”Improving human action recognition with two-stream 3D convolutional neural network”, 978-1-5386-4180-4/18/$31.00 ©2018 IEEE.

[13] Nour El Din Elmadany , Student Member, IEEE, Yifeng He, Member, IEEE, and Ling Guan, Fellow, IEEE ,”Information Fusion for Human Action Recognition via Biset /Multiset Globality Locality Preserving Canonical Correlation Analysis” IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 27, NO. 11, NOVEMBER 2018.

[14] Pavithra S, Mahanthesh U, Stafford Michahial, Dr. M Shivakumar, “Human Motion Detection and Tracking for Real-Time Security System”, International Journal of Advanced Research in Computer and Communication Engineering ISO 3297:2007 Certified Vol. 5, Issue 12, December 2016.

[15] Lalitha. K, Deepika T V, Sowjanya M N, Stafford Michahial, “Human Identification Based On Iris Recognition Using Support Vector Machines”, International Journal of Engineering Research in Electrical and Electronic Engineering (IJEREEE) Vol 2, Issue 5, May 2016

[16] RoozbehJafari, Nasser Kehtarnavaz “A survey of depth and inertial sensor fusion for human action recognition”, https://link.springer.com/article/10.1007/s11042-015-3177-1, 07/12/2018.

[17] Rawya Al-Akam and Dietrich Paulus, ”Local Feature Extraction from RGB and Depth Videos for Human Action Recognition”, International Journal of Machine Learning and Computing, Vol. 8, No. 3, June 2018

[18] V. D. Ambeth Kumar, V. D. Ashok Kumar, S. Malathi, K. Vengatesan and M. Ramakrishnan, “Facial Recognition System for Suspect Identification Using a Surveillance Camera”, ISSN 1054-6618, Pattern

Recognition and Image Analysis, 2018, Vol. 28, No. 3, pp. 410–420. © Pleiades Publishing, Ltd., 2018.

AUTHORS BIBLIOGRAPHY

Mr. Mahanthesha U working as Assistant Professor in the Dept. Of Electronics & Communication Engineering at GSSS Institute of Engineering & Technology for Women, Mysuru, Karnataka, India. His research area is "Image Processing" and pursuing PhD in Visveshwaraya Technological University, Belagavi under the guidance of Dr. H S Mohan, Principal, Navkis College of Engineering, Hassan. He Obtained M-Tech degree in Computer Networking Engineering at National Institute of Engineering, Mysuru under VTU Belgaum in 2014. He obtained his B.E degree in Electronics and Communication Engineering at HMS Institute of Technology, Tumakuru under VTU Belgaum in 2009. He has published many National & International journal and conference papers. He has authored a technical book titled "ROBOTICS MADE SIMPLE - BEGINNERS GUIDE TO BUILDING ROBOT" in 2021. He has 11+ citations in his credit and his areas of interest are Image Processing, Signal Processing and Robotics. He is specialized in Analog Electronic Circuits, Digital Image Processing, Digital Communication, C & C++, Computer Networks, Signals & Systems, DSP and Control Systems.

Dr. H S Mohana, working as Principal at Navkis College of Engineering, Hassan, Karnataka, India. Dr. H S Mohana, completed his BE from AIT, Chikkamagalur, M.E from Indian Institute of Technology, Roorkee. He was awarded PhD for the topic "Real Time Road Traffic Analysis using Differential Techniques and its Evaluation" from VTU, Belgaum, He has over 35 years of teaching experience. Published more than 60 papers in national and international conferences and journals in India and abroad. He has 119+ citations in his credit, His areas of interest include image processing, signal processing, computer vision based instrumentation, digital image processing & pattern recognition etc. He has authored a technical book titled "ROBOTICS MADE SIMPLE - BEGINNERS GUIDE TO BUILDING ROBOT" in 2021. He has attended more than 65 faculty development programs and has organized 20 faculty development programs and workshops. He has several professional memberships such as MISTE, IETE, FIE, IEEE(senior member),ISCSIT Singapore. Worked in several universities positions such as BOE, BOS, Member in VTU and Kuvempu Universities. He worked as VTU Local Inspection Committee member. Reviewed a text book "ELECTRONIC INSTRUMENTATION" By DAVID A BELL, Oxford press for Indian reprint. Successfully guided one candidate for the award of PhD in Jain University and also guiding six PhD students. Successfully guided one M.Sc(Engg) by research at VTU. Honoured as session chairperson in several IEEE International Conferences. He has been recognized as a reviewer for many reputed National and International Journals and Conferences. Written and published a text book titled "Pattern Recognition Techniques for Kannada Script Analysis" in May 5th 2020. Elevated and Recognised as IEEE Senior Member. Working as Executive committee member of IEEE Mysuru Subsection 2021. Working as Permanent Invited Executive committee member of IETE Mysuru Section 2021.Appointed as member BOE-ECE(20-21) by VTU. Recognised as a IEEE CAS Bangalore Chapter-Outstanding Volunteer 2020. In recognition of his Outstanding contribution towards IEEE CAS Bangalore Chapter. Received and completed AICTE grants in the areas of TAPTECH and Research as Principal Investigator. Received DST-FIST grants of worth Rupees 50 lakhs in the year 2018-19.