Real Time Person Identification using Soft Biometric Attributes

B.Tech - CE Semester- V, B.E. – ICT Semester -VIII

Prepared at

ISO 9001:2008
ISO 27001:2013
CMMI LEVEL-5

Bhaskaracharya Institute for Space Applications & Geo-informatics

Science & Technology Department, Govt. of Gujarat.

Gandhinagar

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BISAG, Gandhinagar.

SUBMITTED TO

Charotar University of Science and Technology, Changa &
L.J. Institute of Engineering and Technology, GTU, Ahmedabad

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ISO 27001:2013
CMMI LEVEL-5

CERTIFICATE

This is to certify that the project report compiled by ***Mr. Parmar Rushirajsinh R.,*** *student of 5th Semester* ***B. Tech-CE from Devang Patel Institute of Advanced Technology and Research, CHARUSAT, Changa*** *has completed his Summer Internship satisfactorily. To the best of our knowledge this is an original and bonafide work done by him. He has worked on research project -* ***"Real Time Person Identification using Soft Biometric Attributes"****, starting from May 15th, 2019 to Sept. 24th, 2019.*

During his tenure at this Institute, he was found to be sincere and meticulous in his work. We appreciate his enthusiasm & dedication towards the work assigned to him.

We wish him every success.

Dr. D.K. Jhala

Project Scientist,

BISAG, Gandhinagar

T. P. Singh

Director,

BISAG, Gandhinagar

About BISAG

ABOUT THE INSTITUTE

Modern day planning for inclusive development and growth calls for transparent, efficient, effective, responsive and low cost decision making systems involving multi-disciplinary information such that it not only encourages people's participation, ensuring equitable development but also takes into account the sustainability of natural resources. The applications of space technology and Geo-informatics have contributed significantly towards the socio-economic development. Taking cognizance of the need of geo-spatial information for developmental planning and management of resources, the department of Science and Technology, Government of Gujarat established "Bhaskaracharya Institute for Space Applications and Geo-informatics" (BISAG). BISAG is an ISO 9001:2008, ISO 27001:2005 and CMMI: 5 certified institute. BISAG which was initially set up to carryout space technology applications, has evolved into a centre of excellence, where research and innovations are combined with the requirements of users and thus acts as a value added service provider, a technology developer and as a facilitator for providing direct benefits of space technologies to the grass root level functions/functionaries.

BISAG's Enduring Growth

Since its foundation, the Institute has experienced extensive growth in the sphere of Space technology and Geo-informatics. The objective with which BISAG was established is manifested in the extent of services it renders to almost all departments of the State. Year after year the institute has been endeavoring to increase its outreach to disseminate the use of geo-informatics up to grassroots level. In this span of nine years, BISAG has assumed multi-dimensional roles and achieved several milestones to become an integral part of the development process of the Gujarat State.

BISAG's Journey

2003-04

Gujarat SATCOM Network

2007-08

Centre for Geo-informatics Applications

2010-11

Academy of Geo-informatics for Sustainable Development

2012-13

A full-fledged Campus

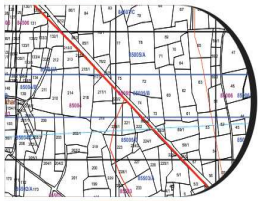
Activities

Satellite Communication..

for promotion and facilitation of the use of broadcast and teleconferencing networks for distant interactive training, education and extension.

Remote Sensing..

for Inventory, Mapping, Developmental planning and Monitoring of natural & man-made resources.

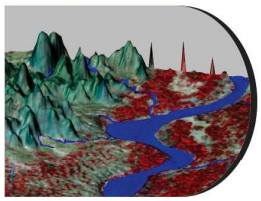


Geographic Information System..

for conceptualization, creation and organization of multi purpose common digital database for sectoral/integrated decision support systems.

Global Navigation Satellite System..

for Location based Services, Geo-referencing, Engineering Applications and Research.

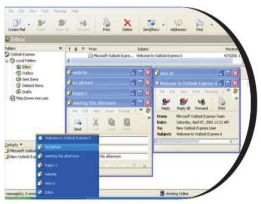


Photogrammetry..

for Creation of Digital Elevation Model, Terrain Characteristic, Resource planning.

Cartography..

for thematic mapping, value added maps.



Software Development..

for wider usage of Geo-spatial applications, Decision Support Systems (desktop as well as web based), ERP solutions.

Education, Research and Training..

for providing Education, Research, Training & Technology Transfer to large number of students, end users & collaborators.

Applications of Geospatial Technology for Good Governance: Institutionalization

Through the geospatial technology, the actual situation on the ground can be accessed. The real life data collected through the technology forms the strong foundation for development of effective social welfare programs benefiting directly the grass root level people. The geospatial data collected by the space borne sensors along with powerful software support through Geographic Information System (GIS), the vital spatio-temporal maps, tables, and various statistics are being generated which feed into Decision Support System (DSS).

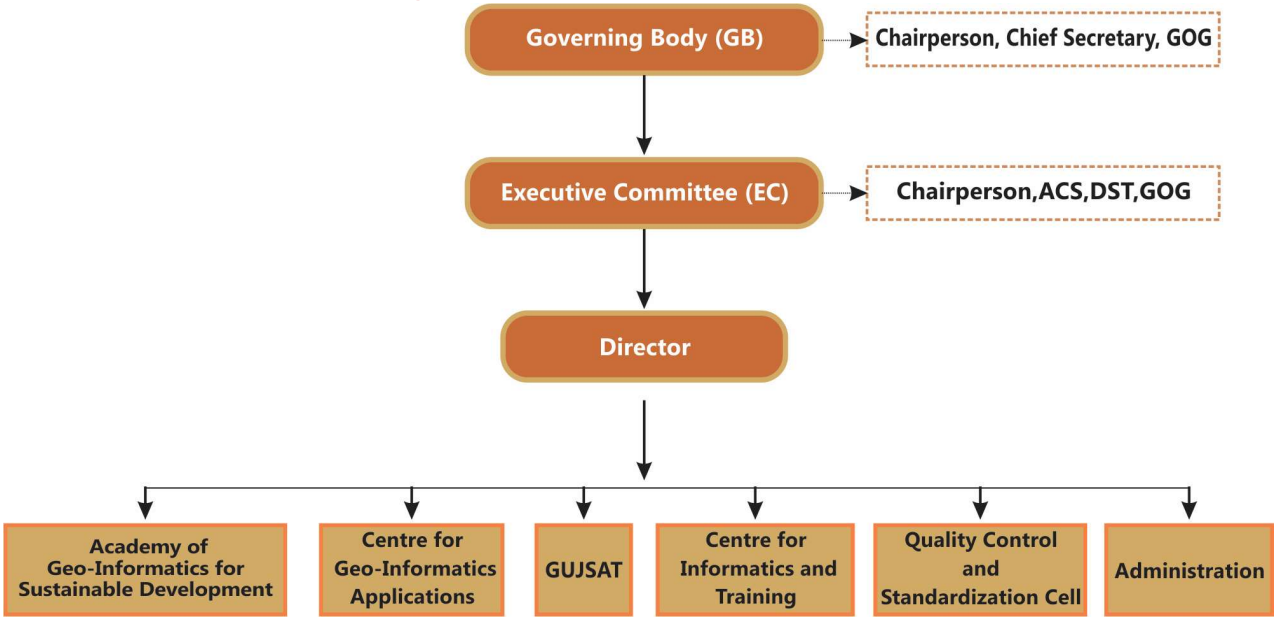
A multi-threaded approach is followed in the process of institutionalization of development of such applications. The 5 common threads which run through all the processes are: *Acceptability, Adaptability, Affordability, Availability and Assimilability*.
These are the "Watch Words" which any application developer has to meet. The "acceptability" addresses the issue that the application developed has met the wide acceptability among the users departments and the ultimate end beneficiary by way of providing all necessary data and statistics required. The "affordability" addresses the issue of the application product being cost effective. The "availability" aspect looks into aspect of easily accessible across any platform, anywhere and anytime. The applications should have inbuilt capability of easy adaptability to the changing spatio- and temporal resolutions of data, new aspects of requirements arising from time to time from users. The assimilability aspect ensures that the data from various sources / resolutions and technologies can be seamlessly integrated.

ACCEPTABILITY	▪ Problem definition by users • Proof of Concept development without financial liability on users ▪ Execution through collaboration under user's ownership
ADOPTABILITY	▪ Applications as per present systems & database ▪ Maximum Automation ▪ Minimum capacity building requirement at the user end
AFFORDABILITY :	▪ Multipurpose geo-spatial database, common, compatible, standardized (100s of layers) ▪ In house developed/open source software ▪ Full Utilization of available assets
AVAILABILITY:	▪ Departmental /Integrated DSS ▪ Desired Product delivery anytime, anywhere in the State
ASSIMILABILITY	▪ Integration of Various technologies like RS, GIS, GPS, Web MIS, Mobile etc.

Organizational Setup

The Institute is responsible for providing information and technical support to different Departments and Organizations. The Governing Body and the Empowered Executive Committee govern the functioning of BISAG. The Institute is registered under the Societies Registration Act 1860. Considering the scope and extent of activities of BISAG, its organizational structure has been charted out with defined functions.

Organizational Setup of BISAG



Governing Body

For smoother, easier and faster institutionalization of Remote Sensing and GIS technology, decision makers of the state were brought together to form the Governing Body. It is the supreme executive authority of the Institute. The Governing Body comprises of ex-officio members from various Government departments and Institutes.

Secretary means : Additional Chief Secretary / Principal Secretary / Secretary of Respective Department of Government of Gujarat

- Chief Secretary, Government of Gujarat ..... Chairperson
- Secretary, Science and Technology ..... Member
- Secretary, Finance Department ..... Member
- Secretary, Education Department ..... Member
- Secretary, Revenue Department ..... Member
- Secretary, Panchayats, Rural Housing and Rural Development Department ... Member
- Director, Space Applications Center, ISRO, Ahmedabad ..... Member
- Dr. George Joseph, Former Director, SAC, ISRO, Ahmedabad ..... Member
- Vice Chancellor, Gujarat University, Ahmedabad ..... Member
- Chief Executive Officer, Gujarat Infrastructure Development Board ..... Member
- Jt. Secretary..... Invitee
- Director, BISAG ..... Member Secretary

Centre for Geo-informatics Applications

Introduction

The objective of this technology group is to provide decision support to the sectoral stake holders through scientifically organized, comprehensive, multi-purpose, compatible and large scale (village level) geo-spatial databases and supporting analytical tools. These activities of this unit are executed by a well-trained team of multi-disciplinary scientists. The government has provided a modern infrastructure along with the state-of-the-art hardware and software. To study the land transformation and development over the years, a satellite digital data library of multiple sensors of last twenty years has been established and conventional data sets of departments have been co-registered with satellite data. The geo-spatial databases have been created using conventional maps, high resolution satellite 2D and 3D imagery and official datasets (attributes).The geo-spatial databases include terrain characteristics, natural and administrative systems, agriculture, water resources, city survey maps, village maps with survey numbers, water harvesting structures, water supply, irrigation, power, communications, ports, land utilization pattern, infrastructure, urbanization, environment data, forests, sanctuaries, mining areas, industries. They also include social infrastructure like the locations of schools, health centers, institutions, aganwadies, local government infrastructure etc. The geospatial database of nagar-palikas includes properties and amenities captured on city and town planning maps with 1000 GIS layers. Similar work for villages has been initiated as a pilot project.

The applications of space technology and geo-informatics have been operational in almost all the development sectors of the state. Remote sensing and GIS applications have provided impetus to planning and developmental activities at grass root level as well as monitoring and management in various disciplines.

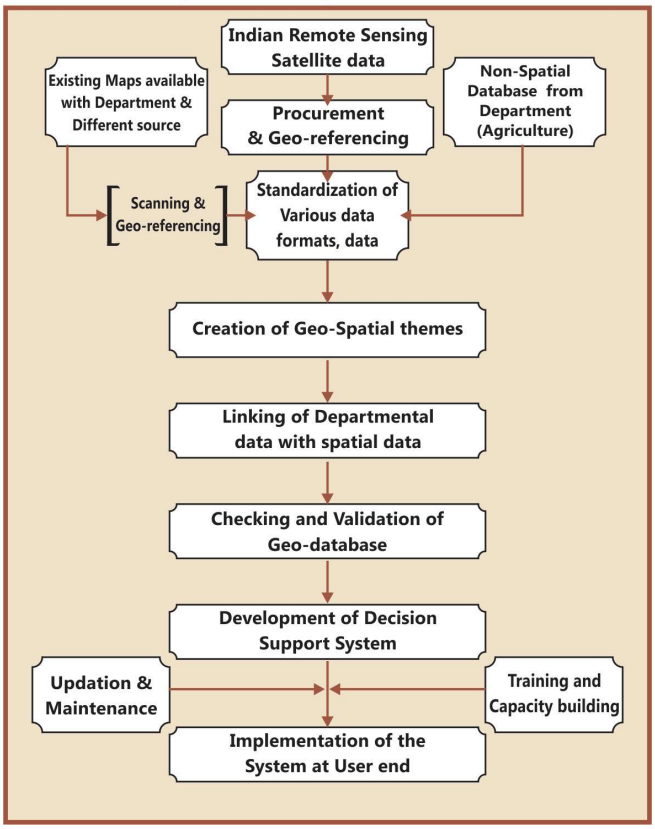
The GIS based Applications Development

The GIS software is a powerful tool to handle, manipulate and integrate both the spatial and non-spatial data. The GIS system operates on the powerful backend data base and Sequential Query Language (SQL) to inquiry the data bases. It has the capability to handle large volume of data and process to yield values of parameters which can be input to very important government activity as Decision Support System (DSS). Its mapping capabilities help the users and specialists in generating single and multi-theme wise maps.

The GIS based applications development has been institutionalized in BISAG. This process can be listed as (Refer Figure for Details)

- Making the users aware of the GIS capabilities through introductory training programme and by exposing to already developed projects as success stories.
- Helping the users in defining the GIS based projects.
- Digitizing the data available with the users and encouraging them to collect any additional data as may be required.
- Generating the appropriate data bases with the full involvement of the users following the data bases standards

Concept of Departmental GIS

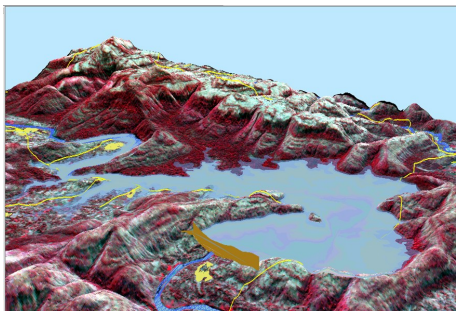


Remote Sensing and GIS Sectoral Applications:

Geo-informatics based Irrigation Management and Monitoring System

- The Geo-spatial information system for Irrigation water Management and Monitoring system for command areas in Sardar Sarovar Narmada Nigam Limited (SSNL) has been developed. Satellite image-based Irrigation monitoring system has been developed in GIS. From the multi-spectral Satellite images of every month, the irrigated areas were extracted.
- The irrigated area were overlaid on the geo-referenced cadastral maps and the statistics of area irrigated has been estimated.
- The user friendly Customized Decision Support System (DSS) has been developed.

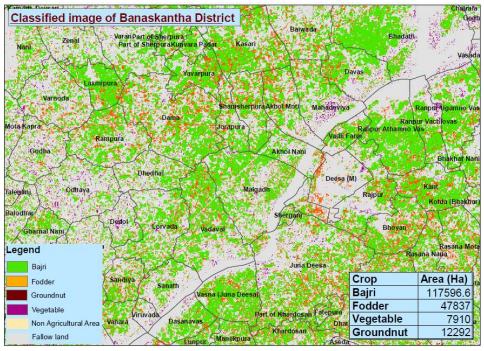
Preparation of DPR of Par-Tapi-Narmada Link using Geo-informatics for National Water development Agency (NWDA)



- The main objective of Par-Tapi-Narmada Link project is to divert surplus water available in west flowing rivers of south Gujarat and Maharashtra for utilization in the drought prone Saurashtra and Kachcha. On the request from NDWA, preparation of various maps for proposed DPR work was undertaken by the BISAG. Land use and submergence maps of proposed dams along with its statistics have been prepared by the BISAG. The detailed work consisted of generation of Digital Elevation Model (DEM), contour generation, Land use mapping, forest area generation of submergence extent at different levels etc.

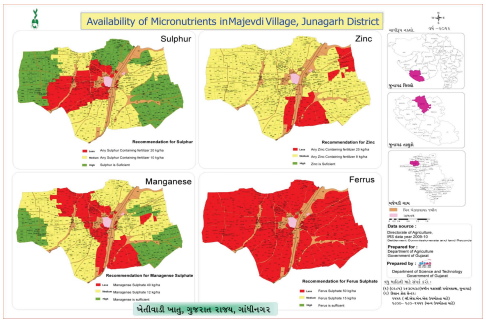
Agriculture

District and Village-level Crop Inventory



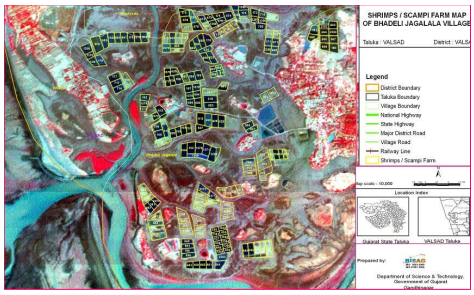
- Remote Sensing (RS) based Village-level Crop Acreage Estimation at was taken up in two villages of Anand and Mehsana districts of Gujarat state. The major objective of this study was to attempt village-level crop inventory during two crop seasons of Kharif (monsoon season) and Rabi (winter season) using single-date Indian Remote Sensing (IRS) LISS-III and LISS-IV digital data of maximum vegetative growth stage of major crops during each season.
- District-level crop acreage estimation during three cropping seasons namely Kharif, Rabi and Zaid (summer) seasons was also carried out in all the 26-districts of Gujarat State. Summer crop acreage estimation Gujarat State was carried out during 2012.

Spatial Variability Mapping of Soil Micro-Nutrients



- The spatial variability of soil micro-nutrients like Fe, Mn, Zn and Cu in various villages of different districts, Gujarat state was mapped using geo-informatics technology. The major objectives of this study were i) to quantify the variability of Mn, Fe, Cu and Zn concentration in soil; ii) to map the pattern of micro-nutrient variability in cadastral maps, iii) suggest proper application of micro-nutrients based on status of deficiency for proper crop management and iv) preparation of village-level atlases showing spatial variability of micro-nutrients.

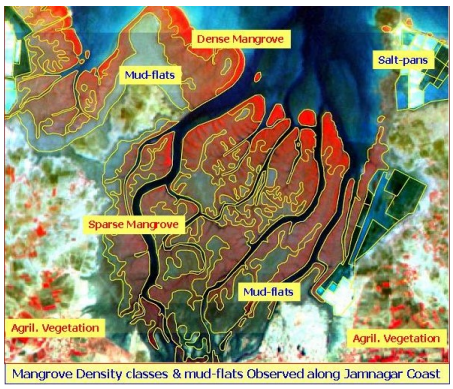
Geo-spatial Information System for Coastal Districts of Gujarat



- The project on development of Village-level Geo-spatial Information System for Shrimp Farms in Coastal Districts of Gujarat, was taken with major objective of development of Village-level Geo-spatial Information System for Shrimp/Scampi areas using Remote Sensing (RS) and GIS. This project was sponsored by the Marine Products Export Development Authority (MPEDA), Ministry of Commerce & Industry, Government of India for scientific management of Scampi farms in the coastal districts which can help fishermen to better their livelihood and increase the economic condition on sustainable basis. The customized query shell was developed using the open source software for sharing the information amongst the officers from MPEDA and potential users. This has helped the farmers to plan their processing and marketing operations so as to achieve better remunerations.

Environment and Forest

Mapping and Monitoring of Mangroves in the Coastal Districts of Gujarat State



Mangrove Density classes & mud-flats Observed along Jamnagar Coast

- Gujarat Ecology Commission, with technical inputs from the Bhaskaracharya Institute for Space Applications and Geo-Informatics (BISAG) made an attempt to publish Mangrove Atlas of the Gujarat state. Mangrove atlas for 13-coastal districts with 35-coastal talukas in Gujarat, have been prepared using Indian Remote sensing satellite images. The comparison of mangrove area estimates carried out by BISAG and Forest Survey of India (FSI) indicates a net increase in the area under mangrove cover. The present assessment by BISAG, has recorded 996.3 sq. km under mangrove cover, showing a steep rise to the tune of 88.03 sq. km. In addition to the existing Mangrove cover, the present assessment also gives the availability of potential area of 1153 sq. km, where mangrove regeneration program can be taken up.

Academy of Geo-informatics for Sustainable Development

Introduction

- Considering the requirement of high end research and development in the areas having relevance of geo-informatics technology for sustainable development, a separate infrastructure has been established. In collaboration with different institutes in the state as well as in the country, R&D activities are being carried out in the areas of climate change, environment, disaster management, natural resources management, infrastructure development, resources planning, coastal hazard and coastal zone management studies, etc. under the guidance of eminent scientists.

- Various innovative methodologies/models developed in this academy through the research process have helped in development of various applications. There are plans to enhance R&D activities manifold during coming years.
- This unit also provides training to more than 600 students every year in the field of Geo-informatics to the students from various backgrounds like water resources, urban planning, computer Engineering, IT, Agriculture in the areas of Remote sensing, GIS and their applications.

- This Academy has been established as a separate infrastructure for advanced research and development through following schools:
  - School of Geo-informatics
  - School of Climate & Environment
  - School of Integrated Coastal Zone Management

- School of Sustainable Development Studies
- School of Natural Resources and Bio-diversity
- School of Information Management of Disasters
- School of Communication and Society

During XIIth Five year Plan advance applied research through above schools shall be the main thrust area. Already M. Tech and Ph.D. students of other Universities/ Institutes are doing research in this academy in applied sciences under various collaborative programmes.

M. Tech. Students' Research Programme

The academy started M. Tech. students' research programme in a systematic way. It admitted 11 students from various colleges and universities in Gujarat, Rajasthan and Madhya Pradesh for period of 10 months from August 2011 to May 2012. All the students were paid stipend of Rs. 6000 per month during the tenure. The research covered the following areas:

- Cloud computing techniques
- Mobile communication
- Design of embedded systems
- Aquifer modeling
- Agricultural and Soils Remote Sensing
- Digital Image processing Techniques (Data Fusion and Image Classification).

The research resulted in various dissertations and publications in national and international journals.

- Now nine students, one from IIT, Kharagpur, three from GTU, one from M. S University, Vadodara and four from GU, are undergoing their Ph. D programme. Out of nine, two thesis have been submitted. Two students are from abroad. One each from Vietnam and Yemen. Since then (after approval of research programme from the Governing Body), 200+ papers have been published by the Academy.

CANDIDATE'S DECLARATION

We declare that final semester report entitled "**Real Time Person Identification using Soft Biometric Attributes**" is our own work conducted under the supervision of the external guide **Dr. D. K. Jhala** from BISAG (Bhaskaracharya Institute for Space Applications & Geo-informatics).We further declare that to the best of my knowledge the report for B.Tech 5th semester does not contain part of the work which has been submitted for the award of Bachelor Degree either in this or any other university without proper citation.

Candidate 1's Signature

Parmar Rushirajsinh R.

Student ID: 17DCE036

Candidate 2's Signature

Kedia Jugal H.

Student ID: 150320132018

Submitted To:

Devang Patel Institute of Advanced Technology and Research

Charotar University of Science & Technology,

Changa, Anand.

ACKNOWLEDGMENT

We are grateful to **T.P.Singh**, **Director (BISAG)** for giving us this opportunity to work the guidance of renowned people of the field of MIS Based Portal also providing us with the required resources in the company.

We would like to express our endless thanks to our external guide **Dr. D.K. Jhala**, And Admin Staff **Mr.Saurabh Bhabhor** and **Mr.Sidhdharth Patel** at Bhaskaracharya Institute of Space Application and Geo-informatics for their sincere and dedicated guidance throughout the project development.

Also our hearty gratitude to the Head of Department, **Dr. Amit Ganatra** from **CHARUSAT** and **Prof**. **Saurin Dave** from **LJIET** for giving us encouragement and technical support on the project.

Parmar Rushirajsinh R

Student ID: 17DCE036

Kedia Jugal H.

Student ID: 150320132018

CONTENTS

1. INTRODUCTION

1.1 Project Details

The goal of the project is to identify a person-of-interest based on specific set of soft biometric attributes from a surveillance video. The project will integrate and minimise semantic gap between human descriptions and soft biometric traits. Moreover this project aims at extracting soft biometric features from an input image or a video frame and then uses these features to identify the person. This project will add another dimension to surveillance as human cognitive perceptions are used while searching the video streams.

1.2 Purpose

Soft biometric traits refer to physical and behavioural traits, such as gender, height, and weight. Such traits are not unique to a specific subject but are useful for identification, verification, and description of human subjects which is under surveillance. GAIT recognition aims essentially to address this problem by identifying people based on the way they walk. Gait is relatively latest, compared to the traditional approaches such as fingerprint, face etc. Biometrics is a technology that makes use of the physiological or behavioural characteristics to authenticate the identities of people. Keeping in view the growing importance of biometric signatures in automated security and surveillance systems, human gait recognition provides a low-cost non-obtrusive method for reliable human identification and is a promising area for research.

One of the most convincing research works in computer vision is carried out in gait-based identification for forensic purposes, as gait is unique and difficult to imitate. The concept of convolutional neural network made a breakthrough in image classification and object recognition. This evolutionary technology can be used in real-time identification and recognition of an individual with its improvised techniques.

1.3 Scope

This approach has its applications in medical field as well besides being used for security purposes. Here are some of its use case:

1. Surveillance System

This project aims at removing the redundancies of existing recognition systems like Facial Recognition, Iris scan , Speech recognition etc. Unlike other recognition systems which focuses mainly on a certain specific characteristic feature set of an individual's body, GAIT Energy Image encompasses entire body movements which are an unique feature set for every individual and can not be imitated.

2. Medical

There is a notable difference in body posture and walking pattern of the person who has been a victim to a serious accident or who has been paralysed for a long time due to the injury sustained in areas like legs, torso or hips. The movement of such persons can be regularly monitored and can be tried further to correct it.

1.4 Goals

The goal of the project is to identify a person-of-interest based on specific set of soft biometric attributes from a surveillance video. The project will integrate and minimise semantic gap between human descriptions and soft biometric traits. Moreover this project aims at extracting soft biometric features from an input image or a video frame and then uses these features to identify the person. This project will add another dimension to surveillance as human cognitive perceptions are used while searching the video streams.

1.5 Study of GAIT Attributes

Gait is an identifying feature of a person that is determined by his/her weight, limb length, and habitual posture. Hence, it is reasonable to use gait as a biometric measure in individual recognition and classification. Gender classification is an important visual task for human beings because a typical social category is gender.

In the domain of soft-biometrics gait is considered to be unique as well as one of the most difficult to deceive feature. Also other soft biometrics can be hide with different masking objects but gait can not be hide which makes it more reliable feature in the surveillance.

Gait Recognition is a cutting-edge biometric technology that recognizes people's body types (physical characteristics such as height, leg bones, muscles, joints, etc.) and walking postures. People can't escape the capture of gait recognition technology by dressing up (such as changing shoes, wearing a hat, wearing a coat, etc.) or changing the walking posture. Therefore, gait recognition is a very important and basically stable biometric recognition technology.

The feasibility of gait recognition technology comes from the difference in human walking posture. Research by Professor Mark Nixon of the Department of Electronics and Computer Science, University of Southampton, UK, shows that everyone has different walking postures because people are in muscle strength and tendon. There are subtle differences in bone length, bone density, visual acuity, coordination, experience, weight, centre of gravity, degree of muscle or bone damage, physiological conditions, and the “style” of individual walking. In the field of intelligent video surveillance, gait recognition technology has advantages over general image recognition.

Technical Advantages	Fingerprint Recognition	Iris Recognition	Face Recognition	GAIT Recognition
Recognition Distance	Contact Type	30 cm	1 - 3metres	25 metres (ordinary HD Camera)
Recognition Angle	Positive	Positive	Acute Positive	360 degree full view
Illumination	No need	Infrared Illumination	Good Light	Non - sensitive to Illumination
Camoflauge	Copyable and Camoflauged	Copyable and Camoflauged	Cover and camoflauged	Hard to Camouflage
Degree of Co-operation	Need to cooperate	Need to cooperate	Need appropriate coordination	No need to cooperate

ADVANTAGES OF GAIT RECOGNITION

Compared with biometric recognition technologies such as fingerprint recognition, face recognition, and iris recognition, gait recognition has advantages:

Gait recognition has a wide range of applications. Real-time gait recognition for people 50 meters away from ordinary 2K cameras .

Gait recognition is uncontrolled identification, which can be recognized without the need for identification objects to actively cooperate and participate. It is also a 360-degree full-view recognition, cross-wearing and cross-attitude.

Gait is difficult to disguise. Different body types, head types, muscle strength characteristics, motor nerve sensitivity, walking posture and other characteristics determine the gait has a better ability to distinguish

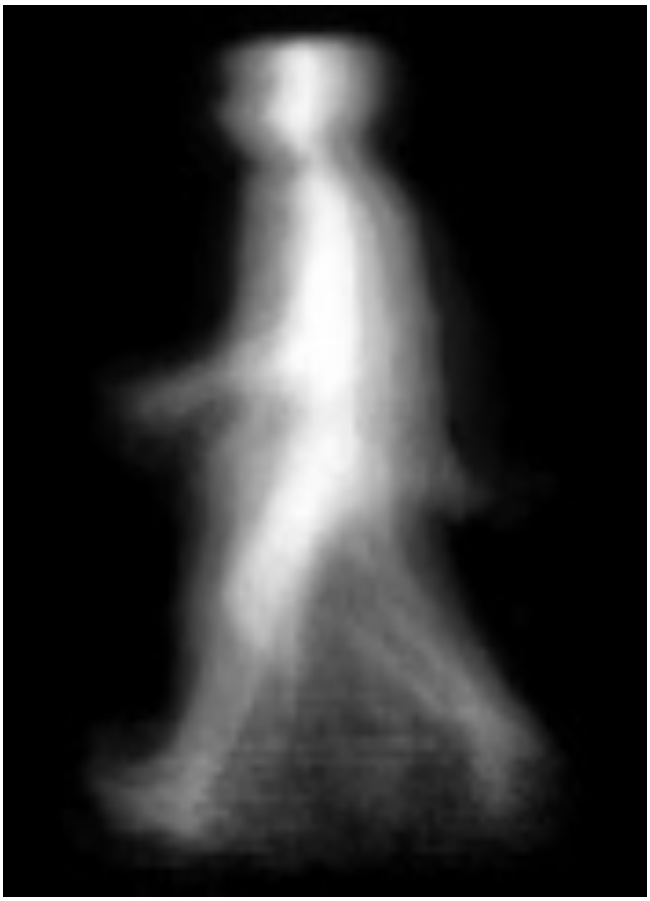
(1) Gait Energy Image (GEI)

If we use all silhouettes in a gait cycle as feature, the feature dimension will be very high. The gait energy image (GEI) can greatly reduce gait feature dimension. GEI, also called average silhouette, is a kind of statistical feature. GEI has been reported to be a good feature in gait recognition because it is robust to silhouette errors and noise. GEI is defined as

$$F(i , j) = 1/T \Sigma I(i, j ,t)$$

Where T is the number of frames in the sequence I (i; j; 1) , I (i; j; t) is a binary silhouette image at frame t , i , and j are the image coordinates.

Gait Energy Image is most used gait feature for computation because of its time and space efficiency. As GEI is a binarised structure of an image, it is a one dimensional structure which occupies less space.

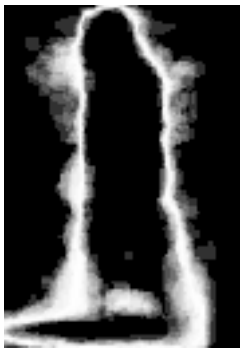


2 Gait Entropy Image (GEnI)

Gait Entropy Image (GEnI) is computed from normalised sil- houettes. First, silhouettes are extracted using background sub- traction from each image frame [11]. Second, the height of the silhouettes are normalised which is followed by the centre alignment. Gait cycles are then estimated using the maximum entropy estimation method in the lower half of the image [11]. Fig. 1 shows examples of normalized silhouettes from the USF, CASIA and SOTON Datasets. The silhouettes from the indoor CASIA and SOTON datasets are clean, whereas the silhouette for the outdoor USF dataset is much more noisy as expected.

USF

CASIA



SOTON

Given a gait cycle of size-normalised and centre-aligned silhouettes, a GEnI is computed by calculating Shannon entropy for each pixel in the silhouette images. Shannon entropy measures the uncertainty associated with a random variable. Considering the intensity value of the silhouettes at a fixed pixel location as a discrete random variable, the entropy of this variable over a complete gait cycle can be computed as

$$H(x,y) = -\sum_{k=1}^{K} p_k(x,y)\log_2 p_k(x,y),$$

where x,y are the pixel coordinates and $p_k(x,y)$ is the prob- ability that the pixel takes on the k^{th} value. In our case the silhouettes are binary images and we thus have K = 2. A Gait Entropy Image G(x,y) can then be obtained by scaling and discretising H(x,y) so that its value ranges from 0 to 255 as follows.

$$G(x,y) = \frac{(H(x,y) - H_{min}) * 255}{(H_{max} - H_{min})},$$

2.2 Details of Tools Used

Tools

- Anaconda (Software development) Virtual Environment

  Anaconda is a free and open-source distribution of the Python and R programming languages for scientific computing (data science, machine learning applications, large-scale data processing, predictive analytics, etc.), that aims to simplify package management and deployment. Package versions are managed by the package management system conda. The Anaconda distribution is used by over 13 million users and includes more than 1400 popular data-science packages suitable for Windows, Linux, and MacOS.

  Anaconda distribution comes with more than 1,500 packages as well as the Conda package and virtual environment manager. It also includes a GUI, Anaconda Navigator, as a graphical alternative to the command line interface (CLI).

  The big difference between Conda and the pip package manager is in how package dependencies are managed, which is a significant challenge for Python data science and the reason Conda exists. Pip installs all Python package dependencies required, whether or not those conflict with other packages you installed previously. So your working installation of, for example, Google Tensorflow, can suddenly stop working when you pip install a different package that needs a different version of the numpy library. More insidiously, everything might still appear to work but now you get different

results from your data science, or you are unable to reproduce the same results elsewhere because you didn't pip install in the same order.

Conda analyses your current environment, everything you have installed, any version limitations you specify (e.g. you only want tensorflow >= 2.0) and figures out how to install compatible dependencies. Or it will tell you that what you want can't be done. Pip, by contrast, will just install the thing you wanted and any dependencies, even if that breaks other things.

- Ubuntu Operating System

Ubuntu is a free and open-source Linux distribution based on Debian. Ubuntu is officially released in three editions: Desktop, Server, and Core. All the editions can run on the computer alone, or e.g. in Windows. Ubuntu is a popular operating system for cloud computing, with support for OpenStack

- Surveillance Camera

A normal HD vision camera would suffice

- Google Colab’s Graphical Processing Unit (GPU)

Colaboratory is a Google research project created to help disseminate machine learning education and research. It's a Jupyter notebook environment that requires no setup to use and runs entirely in the cloud.

Currently Google Colab has introduces Tesla T4 GPU as its Beta version replacing the old Tesla K80 GPU

- Spyder Integrated Development Environment

Spyder is a powerful scientific environment written in Python, for Python, and designed by and for scientists, engineers and data analysts. It offers a unique combination of the advanced editing, analysis, debugging, and profiling functionality of a comprehensive development tool with the data exploration, interactive execution, deep inspection, and beautiful visualization capabilities of a scientific package.

- Jupyter Notebook

• Technologies

- Python Programming Language

Python is a widely used high-level programming language for general-purpose programming, created by Guido van Rossum and first released in 1991. An interpreted language, Python has a design philosophy that emphasizes code readability (notably using whitespace indentation to delimit code blocks rather than curly brackets or keywords), and a syntax that allows programmers to express concepts in fewer lines of code than might be used in languages such as C++ or Java.

The language provides constructs intended to enable writing clear programs on both a small and large scale.

The reason to use python language is that it is very simple as compared to C++ and Java. Moreover, this language also has a vast community that works on deep learning and other domains related to artificial intelligence. Thus, any issue or problems faced by us would be eliminated as quickly as possible

- Machine learning

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves.

The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly.

- Deep learning

Deep learning is a class of machine learning algorithms that use multiple layers to progressively extract higher level features from raw input. For example, in image processing, lower layers may identify edges, while higher layer may identify human-meaningful items such as digits/letters or faces.

- Computer Vision (CV)

Computer vision is an interdisciplinary field that deals with how computers can be made to gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to automate tasks that the human visual system can do. "Computer vision is concerned with the automatic extraction, analysis and understanding of useful information from a single image or a sequence of images. It involves the development of a theoretical and algorithmic basis to achieve

automatic visual understanding." As a scientific discipline, computer vision is concerned with the theory behind artificial systems that extract information from images. The image data can take many forms, such as video sequences, views from multiple cameras, or multi-dimensional data from a medical scanner. As a technological discipline, computer vision seeks to apply its theories and models for the construction of computer vision systems.

- Transfer Learning

Transfer learning is a machine learning method where a model developed for a task is reused as the starting point for a model on a second task.

It is a popular approach in deep learning where pre-trained models are used as the starting point on computer vision and natural language processing tasks given the vast compute and time resources required to develop neural network models on these problems and from the huge jumps in skill that they provide on related problems.

- Libraries: OpenCV, Scipy, Tensorflow, PyTorch, PIL etc.

3. System Analysis

3.1 Existing System

Currently there are no existing systems or frameworks which are capable for identification purposes using GAIT Attributes but an indirect comparison can be made with Facial Recognition/ Iris Recognition or Speech recognition systems.

3.2 Problem Identification

Few of the problems with this recognition systems are distance of recognition , recognition angle , illumination , camouflage and degree of cooperation. To overcome this problems, a robust and a near to flawless system is required and use of GAIT attributes for recognition/ identification is the plausible solution.

3.3 Feasibility Study

The feasibility of gait recognition technology comes from the difference in human walking posture. Research by Professor Mark Nixon of the Department of Electronics and Computer Science, University of Southampton, UK, shows that everyone has different walking postures because people are in muscle strength and tendon. There are subtle differences in bone length, bone density, visual acuity, coordination, experience, weight, centre of gravity, degree of muscle or bone damage, physiological conditions, and the “style” of individual walking. In the field of intelligent video surveillance, gait recognition technology has advantages over general image recognition.

3.4 System Requirement

Functional Requirements

Under the functional requirement, it includes the feature that system/product must have, following are the functional requirements;

(1) The system should be able to distinguish person from its background irrespective of lighting condition.

(2) The system should be able to perform the task of recognizing person within short period of time (in seconds).

(3) The system should be able to perform on Image input as well as Video and real-time stream input of data.

(4) The system should present its Prediction (i.e. Name of the person in Frame) along with Confidence level of Prediction in real-time.

(5) The system should be available for offline execution of task on a local machine.

(6) The system should be capable of handling data from file system as well as database system.

(7) The system should be pose and structure invariant. Meaning, it should be able to recognize the person in frame irrespective of his/her posing.

(8) The system should generate error as and when required, without abruptly crashing.

Non-Functional requirement

The non-functional requirement for the system, requirement that is optional, that may or may not affect the product directly. The non-functional requirement for the system is:

(1) Availability: The system performs real time GAIT recognition and analysis

(2) Durability & Robustness: The system available, is robust to physical as well as abstract disturbance.

(3) Reusability: The system is reusable in multiple field of application.

(4) Reliability & Accuracy. The system is one of the most accurate one available in market.

(5) Data Integrity: Due to admin control over system, Data Integrity of the system is maintained.

(6) Portability: The system is easily portable with services accessed from any location.

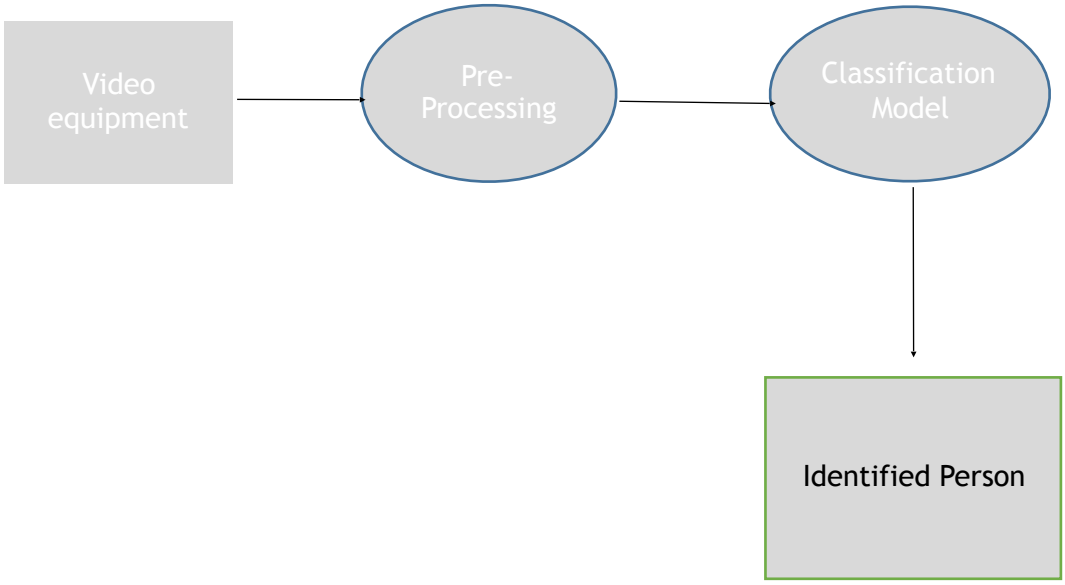
(7) Security: The system is secure against unauthorized access to data or resources.

(8) Maintainability: The system is easily manageable.

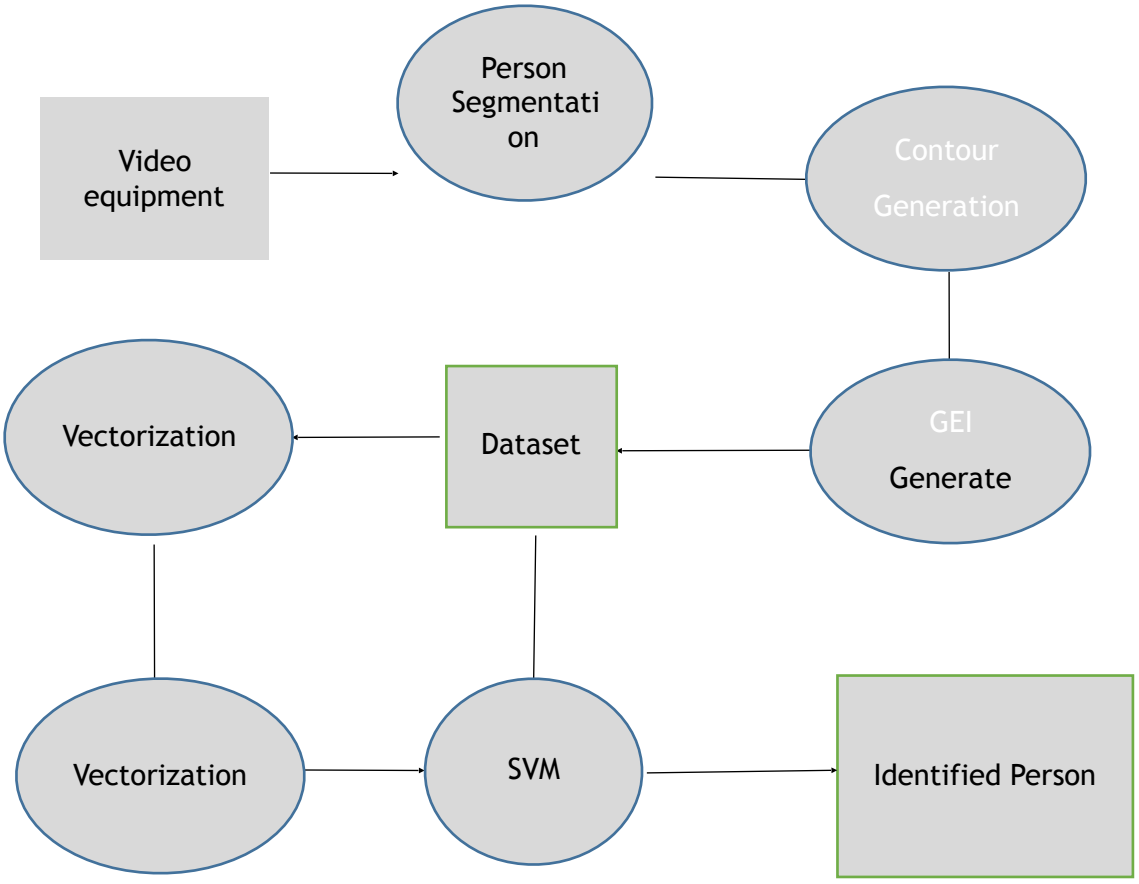
4. System Design

4.1 Data Flow Diagram

DFD 1:



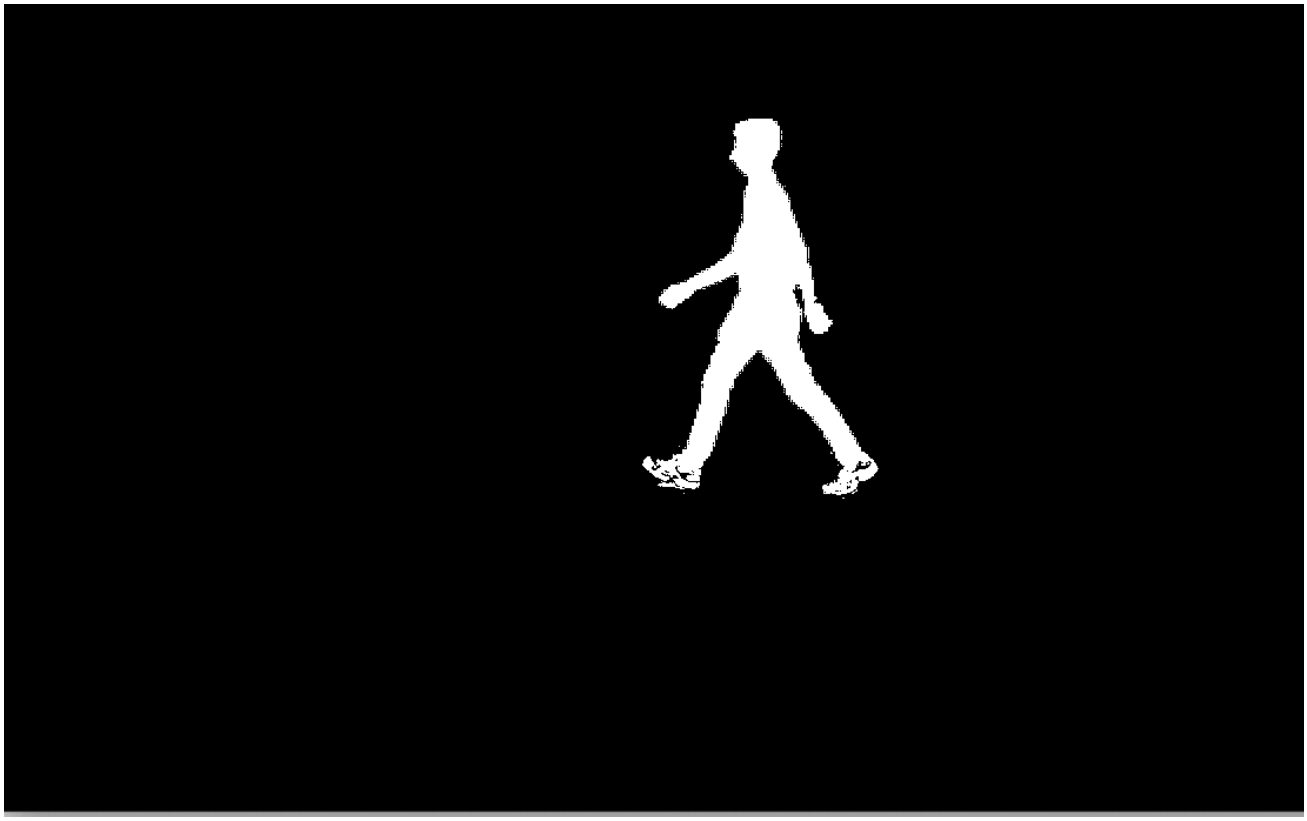
DFD 2:

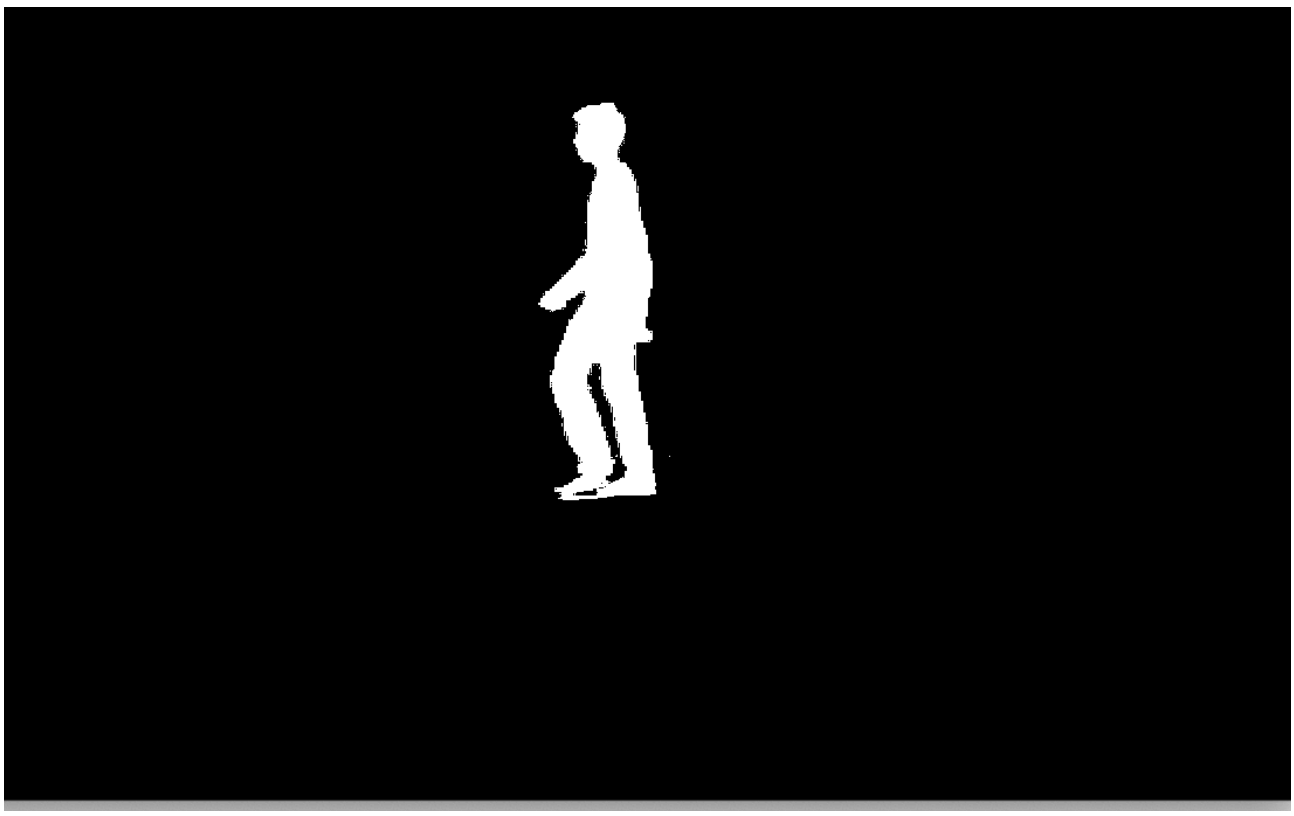


5. ScreenShots

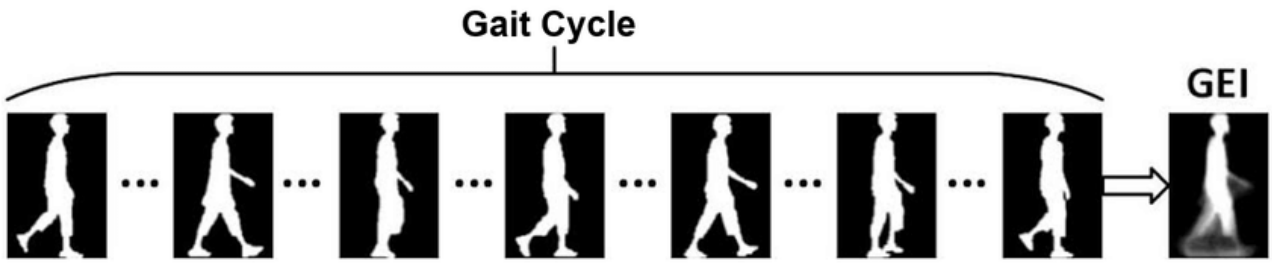
Actual Footage Screenshot

Silhouette

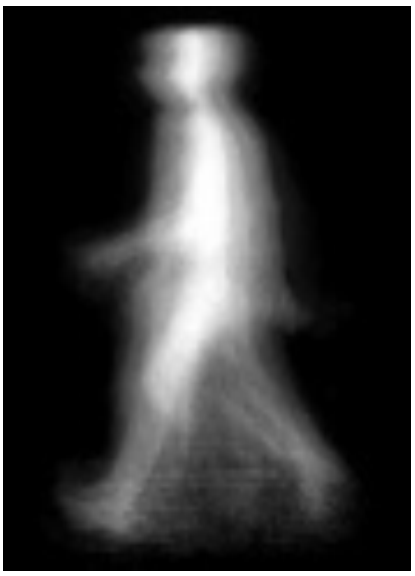




GAIT Cycle



GAIT Energy Image



6. System Testing

This model has been tested on video stream recorded in challenging external environment which gives us real time accurate results in presence of shadows, reflection, illumination conditions etc.

In presence of shadow, reflection and lightning conditions

After Fine-Tuning the algorithm to remove shadow and reflection

7. System Evaluation

After processing the data, a dataset consisting 300 GEI was created. 75% of the data was used for model training purposes. In this split, the accuracy obtained during training was 94.6%, on validation set - 89% and on testing data - 86.6%

8. Limitations and Future Enhancement

Currently this system works at 10-12 FPS on Tesla T4 GPU, use of appropriate computational hardware may lead the system to work on 25-30 FPS

Our current methodology works on a single person at a given instance of time which can be enhanced further to make it work on multiple persons at a time and at multiple view angle.

9. Conclusion and Bibliography

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Project Name: ***Real Time Person Identification using Soft Biometric Attributes***

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