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Journal of Theoretical and Applied Informtion Technology
May 2019 | Vol. 97 No.09

Title:	ANALYSIS OF ACCEPTANCE OF MOBILE PAYMENT AS AN ALTERNATIVE TRANSACTION OF PARKING PAYMENT
Author:	ARRY NOVRIALDY LESMANA, SFENRIANTO
Abstract:	OVOs mobile payment application is a Micro Payment application that is developing as a means of payment (electronic money) on smartphones. The application is divided into two, namely OVO Cash and OVO Point. OVO Cash can be used for various types of financial transactions, such as payments at various merchant partners, top up, and balance checking. At present, it's easy to make transactions quickly and easily using OVO Cash. OVO Points are loyalty rewards obtained by OVO users when making transactions at various OVO partner merchants. The advantages of the OVO application with the mobile payment application is that the OVO application can make payment transactions for parking rates at the mall. For example, the Lippo mall in the Jakarta area has implemented the first automate self-parking payment system in Indonesia and the parking fee payment is operated in May 2017. This case study aims to find out the receipt of the OVO payment mobile application as a payment for tariffs. parking, in this study uses the UTAUT model as a research method in order to find out whether performance expectancy, effort expectancy, social influence and facilitating conditions influence the behavior intention on the OVO mobile payment application. Through regression statistical test analysis as processing data obtained from questionnaires with the number of 100 respondents using the OVO mobile payment application as a payment tool for parking rates. The data collection technique carried out is a non-probability approach that is using purposive sampling. Sampling with purposive sampling is a sampling technique of population earned on certain criteria in order to get the conclusions of this study, includes performance expectancy, effort expectancy, social influence and facilitating conditions affect behavior intention.
Keywords:	Mobile Payment, Application Smartphone OVO, Unified Theory of Acceptance and Use of Technology (UTAUT) Model Dimensions.
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	METHODS AND MODELS OF SELF-TRAINED AUTOMATED SYSTEMS DETECTING THE STATE OF HIGH-SPEED RAILWAY TRANSPORT NODES
Author:	AKHMETOV B., LAKHNO V., ORALBEKOVA A., KASSIMOV B., SULTANGAZINOV S.
Abstract:	The article contains the results of researches aimed at the further development of methods and models for self-trained automated detection systems (SADS) of nodes and aggregates of high-speed railway transport (HSRT) based on the clustering of failure signs. There has been developed SADS model of nodes and aggregates of HSRT and a method for its training, in which the procedure of fuzzy clustering of failure signs realization is applied. The procedure for decision rules correction is also considered, that will allow the creation of adaptive self-trained mechanisms for automated systems for detecting HSRT nodes and aggregates. It is proposed to use the modified information condition of functional effectiveness (ICFE) as an evaluation indicator of the training effectiveness of SADS. This condition is based on Kullback-Leibler information-distance criteria. There is considered the method of space fragmentation of failure signs realization of the HSRT nodes and aggregates into clusters during the implementation of the failure recognition procedure. Also there is considered the method of initial training of SADS. The method is an iterative procedure for finding the global maximum of ICFE. There were substantiated perspectives of decisions on the integrated evaluation of the detection results of the nodes and aggregates of the HSRT rolling stock based on the use in similar automated complexes for detecting models with fuzzy clustering algorithms of hundreds of the HSRT failure signs systems.
Keywords:	Non-Destructive Control Methods, Railway Rolling Stock, Feature Clustering, Kullback-Leibler Criterion
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	REAL-TIME MOTION DETECTION FOR STORAGE VIDEOS IN SURVEILLANCE CAMERAS
Author:	MOHAMED G. EL-SAID , MOHAMMED ELMOGY , AHMED ABOELFETOH

Abstract:	Recently, motion detection is essential in computer vision applications because of the significant demands for developing digital video reordering systems (DVR). In this paper, we present a new technique for motion detection, which can handle the challenges of motion detection. The proposed technique can be used in real-time surveillance camera systems. It can capture the motion from any camera that is extracted from each enrolled images or video for each moved objects. We implemented the processing and dissemination stages for the processed images that are used for digital surveillance systems. On the other hand, the need for high recording quality with the increase of camera numbers required huge storage space. Therefore, we used a registration point in the case of traffic motions. In order to take advantage of storage space that made high benefits with four different processes of first obstacles of motion detection, the speed of the moving object, the presence of mobile cameras, moving background algorithm that responsible for detecting movement. A comparative study is presented in this paper to investigate the reliability and robustness of the proposed system.
Keywords:	Motion Detection, Background Subtraction, Temporal Difference, Optical Flow, Grid Processing, Area Highlight, Object Tracking, Border Highlight.
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	ALGORITHM OF PARALLEL DATA PROCESSING IN THE AUTOMATED DISPATCHERIZATION SYSTEM OF RAILWAY TRANSPORT MOVEMENT
Author:	AKHMETOV B., LAKHNO V., YERKELDESSOVA G., SARZHANOV T., MUSSAYEVA G.
Abstract:	The article is devoted to the following tasks. There is a substantiation of the need to solve the problem of increasing the efficiency of automated dispatching control systems (ADCS) of the rolling stock (RS) movement of railway transport, in particular high-speed (HSRT) by applying a technology that involves paralleling of calculations in the ADCS subsystems that implement coordination of RS movements. There were substantiated the principles of RS division into groups. It is shown that this separation will increase the speed of the calculations, especially in situations where time constraints are imposed on obtaining results in the ADCS. There is proposed an algorithm that allows for the subsequent stages of the research to implement programmatically the solution of tasks related to the coordination of movement and PS graphics. Unlike existing solutions, the proposed algorithm takes into account the possibility of using parallel computing technologies. There is also proposed a mathematical model that reflects the principle of separation of computational processes for the purpose of their execution in parallel mode. There was carried out a preliminary assessment of the effectiveness of the use of parallel computing technologies in tasks solved by ADCS. In particular, there are considered tasks that involve solving problems related to the RS coordination of a railway transport, including high-speed railway transport of the Republic of Kazakhstan.
Keywords:	Railway Transport, Dispatching, Automated Control System, Parallel Algorithm, Movement Coordination
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	COMPARISON BETWEEN THE RESULTS OF IMPLEMENTATION OF SENSORLESS SLIDING MODE CONTROL USING SLIDING MODE OBSERVER AND SENSORLESS SLIDING MODE CONTROL USING MRAS-HG OBSERVER OF AN INDUCTION MOTOR ON AN FPGA BOARD
Author:	SGHAIER NARJESS, BEN AMMAR IMEN, MIMOUNI MED FAOUZI
Abstract:	In this paper we will focus on the results of the implementation on an experimental test bench of an Induction motor using the FPGA Board of two types of sensorless sliding mode control. A comparison will be made between the results obtained from the sensorless sliding mode control based on the one part on an sliding mode observer and on the other part on a MRAS-HG observer.
Keywords:	Induction Motor, FPGA, Sensorless Control, Sliding Mode observer, MRAS-HG observer, experimental test bench
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	MIGRATING APPLICATIONS TO CLOUDS WITH TOGAF FRAMEWORK AT MERAKI DIGITAL INDONESIA
Author:	INDRA RANGGADARA, NILO LEGOWO, SFENRIANTO
Abstract:	The main problem in this study is the problem of maintenance costs that must be spent on an annual basis by the company, so as to reduce costs incurred efficiently, migration with the TOGAF approach is needed in designing applications in the cloud system, and SWOT analysis is also performed to see strength, weakness, opportunities, and threats before and proposed migration carried out as a consideration in implementation. The design carried out illustrates the entire application that is designed and migrated in the cloud and mixes service design with SOA to support calling services at the function system, and in this study

	using data sources and instruments based on primary data and secondary data, as well as analysis techniques needed in this study. The results in this study of migration carried out using the steps in TOGAF and analyzed by SWOT which found advantages and disadvantages in this implementation.
Keywords:	Application, Cloud, Migration, SWOT, TOGAF
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	AN ALGORITHM TO DETECT AN OBJECT IN A CONFINED SPACE BY USING IMPROVED FINGERPRINTING APPROACH
Author:	IMMANUAL, SHONEY SEBASTIAN
Abstract:	The rapid evolution of location-based services has made tremendous changes in the society. In this paper, Trilateration method is implemented in fingerprinting methodology to obtain very precise and low error position details of the client portable device. Trilateration is a method in which the portable device is determined by the received signal strength intersecting at one position from the three reference points. Fingerprinting method involves several steps like training stage and positioning stage in which the training stage consists of the creation of the database of the signal strengths along with its associated location measurements. In the positioning step where effective and efficient received signal strength collected from the portable device is matched with the data saved into the database to get the position information of the client. The position of the user is estimated by collecting the received signal strengths from three reference points by using the concepts of trilateration approach in fingerprinting methodology to obtain more precise and accurate information.
Keywords:	Fingerprinting, Trilateration, Received Signal Strength, Wi-Fi, Indoor Positioning System.
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	CONVERGED CITIZEN SERVICE IOT PLATFORM REFERENCE MODEL FOR SMART CITIES
Author:	AIGERIM ALTAYEVA, RAISSA USKENBAYEVA
Abstract:	Growth of densely populated urban areas brings multiple problems associated with high population density. A Smart City is a new way of managing urban environments with the help of the latest advancements in technology. In this paper we analyze the Smart City related research and conceptualize the smart city platform. We explore the definition of smart cities from a scientific, technological and economic point of view and discuss what defines a smart city platform. In the second part of the paper we discuss a multilayer smart city platform model. The model is aimed to define the components of a smart city and to combine them together into layers. Creating such a logical structure will allow easier development of a scalable and easily maintainable smart city platform.
Keywords:	Network, Platform Reference Model, Smart City, Smart City Platform
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	OVERVIEW AND IMPLEMENTATION OF THE TWO MOST IMPORTANT CANDIDATE 5G WAVEFORMS
Author:	ALI JASIM RAMADHAN
Abstract:	Interconnectivity of devices means that 5G is expected to handle high data rates, and even the lowest hierarchy of 5G systems should be flexible. The flexibility of the 5G waveform is important to ensure that different types of traffic can be managed within the same band. In this study, three multicarrier waveforms, namely, the filter bank multicarrier (FBMC), conventional orthogonal frequency division multiplexing (OFDM), and upcoming universal filtered multicarrier (UFMC) waveforms, were analyzed in terms of the probability of error with respect to changes in some operational parameters. These new types of waveforms are ideal for future needs because they solve the problem of time-frequency synchronization. They can support the fragmentation of spectrums because they rely on improved techniques of spectrum localization, which means that they can combine different traffic specifications. The response time is very vital for transmitting very small bursts of information, and 5G simulation tests show a significant benefit regarding the time-frequency efficiency. Because of the cyclic prefix, OFDM and FBMC tend to perform poorly when transmitting short bursts. UFMC performs better than FBMC when transmitting short packets; its performance was better than that of OFDM by 10% in all scenarios. Long sequence tests show that the performance of both FBMC and UFMC are the same.
Keywords:	FBMC, OFDM, UFMC, 4G, 5G
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	AN EFFICIENT INFORMATION RETRIEVAL IN MESH (MEDICAL SUBJECT HEADINGS) USING FUZZY
Author:	C.SENTHIL SELVI , Dr. N. VETRIVELAN
Abstract:	The job of an Information Retrieval framework is to help clients to get to significant data comparing to their necessities. In the therapeutic area, getting to valuable data turns out to be progressively essential with the developing measure of accessible data. Be that as it may, clients are for the most part new to therapeutic terms and discover troubles communicating their necessities. One intriguing arrangement is to coordinate fuzzy ontologies with the end goal to accomplish semantic interoperability and offer an approach to deal with dubious and uncertain data in regards to the restorative field. In this research, our point is to play out a successful information retrieval by expanding its comprehension of equivocal restorative ideas. In proposed fuzzy medical ontology based medicinal information retrieval approach which is made out of three parts: customized medical terminology framework, contextualized fuzzification of the customized mesh ontology and a searching keyword reordering process dependent on the subsequent fuzzy philosophy. A model has been executed permitting test assessment of the proposition. Our result expected how the search keyword query reordering has prompted a quality outcomes change.
Keywords:	Fuzzy, Information Retrieval, Medical Terminology, Content Extraction, Accurate Result
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	FACE RECOGNITION IN VIDEO SURVEILLANCE SYSTEMS AS AN APPLICATION OF SMART CITIES
Author:	BAUYRZHAN OMAROV, NURZHAN OMAROV, ALUA SARBASOVA, SAYA SAPAKOVA, TURSYNAY KOISHIYEVA, NURZHAN KALIYEV, ARMAN KOISHIBAYEV, BATYRKHAN OMAROV
Abstract:	Face Detection and Recognition is an important surveillance problem to provide citizens security. Nowadays, many citizen service areas as airports, railways, security services are starting to use face detection and recognition services because of their practicality and reliability. In our research, we explored face recognition algorithms and described facial recognition process applying Fisherface face recognition algorithm. This process is theoretically justified and tested with real-world outdoor video. The experimental results demonstrate practically applying of face detection from several foreshortenings and recognition results. The given system can be used in building a smart city as a smart city application.
Keywords:	Smart City, Video Surveillance, Face Recognition, Face Detection
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	AN INTELLIGENT WATERMARKING ALGORITHM FOR 3D MODELS BASED ON FUZZY INFERENCE TECHNIQUE
Author:	ZAINAB N. Al-QUDSY, SHAIMAA H. SHAKER, NAZHAT SAEED ABDULRAZQ
Abstract:	In this paper, we propose new and robust 3D model watermarking method. Firstly, Fuzzy C-mean (FCM) algorithm clusters 3D mesh vertices into proper and improper regions for embedding the watermark to improve the imperceptibility. Afterward, the geometrical features are extracted using the mean curvature of vertices, area of triangular faces and angles between the faces normal and the average normal for rings around vertices. Further, the geometrical features are fed to fuzzy inference system (FIS) that give weights for vertices to indicate the relevance of the vertices to hiding the watermark and enhance the robustness. Finally, the watermark is blindly extracted without needing for the original models after the application of various types of attacks. The performance evaluation shows high imperceptibility and tolerance against attacks, such as addition of noise, smoothing, cropping, translation, and rotation. The proposed algorithm has been successfully designed, implemented, and tested.
Keywords:	3D model watermarking, Mean curvature, Geometrical properties, Fuzzy inference system, Fuzzy C-mean clustering.
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	ANALYSIS OF THE IMPLEMENTATION QUANTUM GIS: COMPARATIVE EFFECT AND USER PERFORMANCE
Author:	M.TRI SATRIA JAYA , AHMAD NURUL FAJAR
Abstract:	The purpose of this research is to analyze the effect sucess information system Quantum GIS on the user performance in the company PDAM Bengkulu City with the measurement of the system quality, information quality, use, and user satisfaction as an independent variable and user performance as the dependent variable. This research employs a qualitative analysis approach based on the Delone and McLean s model of sucess to

	analyze the data which is designed to resemble the likert scale and was previously tested on the validity and realibility using SEM PLS method. The results showed that the variable system quality, information quality, the use of the system and user satisfaction affect the user performance of 0,99 or 99%. The level of influence of the largest independent variables in the successful application of Quantum GIS information systems in PDAM Bengkulu City is the user satisfaction with the highest value of the original estimate of 0.495. From the results of hypothesis testing that the system quality have a significant effect on user satisfaction and user performance. The quality of information significantly affects user use, user satisfaction and user performance and user saisfaction significantly affects user performance. While the influence of system quality and system usage is not significant to user performance. System quality is also not significant to usage.
Keywords:	Information systems Quantum GIS, user performance
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	BARRIERS TO E-LEARNING IN DEVELOPING COUNTRIES: A COMPARATIVE STUDY
Author:	SOLOMON OLUYINKA, ANATALIA N. ENDOZO
Abstract:	Technology and its applications have given tertiary-organizations a better operating system to broaden their education, learning anywhere and at any time made flexible with adoption of technology that is globally accepted. Several studies investigated factors hindering, influencing or significant to technology acceptance. Unfortunately, comparing technology acceptance in terms of two or more developing countries seems not fully investigated, especially in the area of learning via web in the developing countries, rather than developed countries. This study employed technology acceptance model (TAM) to compare the factors affecting e-learning among the Nigeria and Philippines students, modules/part-time students in universities approved for specified technology considered as the unit of analysis. AMOS-SPSS utilized to the analyse sum of 1306 responses for the two counties. Hypothesized; electric supply, technical resources, ease to use and perceived usefulness on e-learning supported, 69% and 80% variance explained of the study achieved. Although, electric supply regressed on perceived ease not supported. Thus, recommended the replication of this study to increase the generalizability of achieved results.
Keywords:	Technology Acceptance Model, AMOS-SPSS, Online Learning, Nigeria, Philippines
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Title:	THE MEDIATING EFFECT OF INFORMATION SYSTEM ARTEFACT (ISA) BETWEEN EMPLOYEE BEHAVIOUR AND ORGANIZATIONAL RESILIENCE
Author:	SHUBASHINI RATHINA VELU, DR SHARMINI GOPINATHAN, PROF MURALI RAMAN
Abstract:	The purpose of this paper is to analyse the relationship between the employee behaviour with Information System Artefact (ISA). However, this relationship does not arise directly. The authors argue that the employee behaviour in organization has a positive effect on the use of Information System Artefact (ISA) tools and processes due to employees are facing a lot of challenges in handling complexity of job and this subsequently increase human errors. Increase of human errors in organization contributes to disasters thus impact the organizational resilience. Information System Artefact (ISA) and the usage are tools to simplify employees work practises and processes to achieve better organizational resilience. This study aims to determine whether Information System Artefact (ISA) mediate in the relationship between employee behaviour in organization and organization resilience on companies listed under Malaysian Digital Economic Corporation Sdn. Bhd. (MDEC) during the period of 2000 to 2018.The main finding is that the role of employees behaviour positively affects the use of Information System Artefact (ISA) thus enhances organization resilience. The study is a new contribution for academics and practitioners, since the Information System Artefact (ISA) and behaviours is tested in education practises for adult learners and students instead over employees on disaster management practices and organizational resilience. In addition, the effect of artefact has been studied in organization routines and security context instead of in disaster management. The study has two practical implications for companies to continue working for sustainability. The first practical implication is the need to work the processes that are aimed at the exchange of information that are simplified both internally and externally to the organization. The second practical implication, that has been determined several enhancement initiatives for resilient organizations that may contribute towards the strategic goals of Sendai﷽s framework (2015﷽2020). These enhancement initiatives help to cultivate a new dimension of behavioural capacities among employees. Moreover, it raises awareness of risk with relevant lead and follows indicators to recognise trend, emerging risks, and opportunities. Thus, risk attitude for each main type of operational risk must be identified for guidance using symbols or artefacts that can position the risk.
Keywords:	Mediation, Employee behaviour, Information System Artefact (ISA), organizational resilience, Human error
Source:	Journal of Theoretical and Applied Information Technology 15th May 2019 -- Vol. 97. No. 09 -- 2019

Full Text

Journal of Theoretical and Applied Information Technology
15th May 2019. Vol.97. No 9

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

FACE RECOGNITION IN VIDEO SURVEILLANCE SYSTEMS AS AN APPLICATION OF SMART CITIES

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ABSTRACT

Face Detection and Recognition is an important surveillance problem to provide citizens' security. Nowadays, many citizen service areas as airports, railways, security services are starting to use face detection and recognition services because of their practicality and reliability. In our research, we explored face recognition algorithms and described facial recognition process applying Fisherface face recognition algorithm. This process is theoretically justified and tested with real-world outdoor video. The experimental results demonstrate practically applying of face detection from several foreshortenings and recognition results. The given system can be used in building a smart city as a smart city application.

Keywords: *Smart City, Video Surveillance, Face Recognition, Face Detection*

1. INTRODUCTION

If we talk about the concept of "smart city", first and foremost, it is improving the quality of life and creating comfortable living conditions for citizens. This is the combination of various technologies, management of communications, infrastructure, in the near future IOT.

1.1 Smart City

The goal is the optimal use of modern technologies in each of the spheres of city life for more rational use of resources and improving the quality of life, doing business, etc. So, "Safe City" is the most important component of the "smart city" concept, besides video surveillance as part of a safe city, the state is becoming "the eyes" of a smart city. Smart cities often intersect with a digital city, a wireless city, a safe city, an eco-city, a city with low carbon monoxide emissions, architectural perfection and other regional development concepts. This should be confused with the concepts of the industry of information technologies, electronic document management, electronic reporting, intellectual transport and an intelligent urban water / gas / power supply network. Smart City is sharing data over the Internet, cloud services, geospatial infrastructure, dedicated telecommunication channels and other new generations of information technology. CCTV cameras, included in open or protected monitoring and control systems, ensure broadband cross-border interaction of all municipal structures, facilitate the intellectual integration of applications into user innovations, open innovations, public innovations, joint innovations. The process of transition to a smart city is characterized by a steady interest of both local enterprises and foreign investors. In this process there are no templates for the use of video surveillance and network technologies. The main thing is an intelligent and cost-effective result. And here, of course, there are increased requirements to the processing of video data streams, the quality of video surveillance equipment.

Modern cities, especially megacities, in recent years have become sources of increased risk for their citizens and visitors. These are not ceasing acts of a terrorist nature, rampant criminal passions, traffic tensions and constant accidents on city roads, offenses at railway facilities and airports, threats to critical infrastructure of cities. We need new

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

approaches, new solutions. First of all, the intellectualization of security systems.

The security and livelihood systems of today, developed by our tandem, are distinguished by a multi-format, open architecture that allows you to respond very flexibly to the demands of security professionals, to take into account many factors that distinguish a modern city. Developed IP solutions made it possible to provide live remote monitoring of objects from anywhere in the world. Concern about protecting the security systems themselves led to such mandatory attributes as fail-safe archiving with redundancy, support for cryptographic algorithms.

1.2 Recognition Systems in Smart City

The newest video analytical automation systems for urban video surveillance systems should include the following minimum cycle: detection - recognition - classification - response - investigation - documentation. Moreover, the delays between the stages of this essentially unified process should be minimal — minutes, in rare cases — hours. That's when confidence and security will come to our cities. And in the townspeople there will be peace and understanding that the authorities are not only concerned, but they are doing everything to make people confident in their future.

Recognition system is a hardware-software complex for automatic verification or identification of a person using a digital image. The task of face recognition is solved when creating access control systems, automated passport control systems, when conducting operational search activities, etc. [1].

In the process of face recognition, a number of difficulties arise associated with the influence of lighting conditions, head rotation, and age-related changes on recognition results.

The following main stages of the verification and identification process [2] are distinguished: registration and normalization of the image; feature selection; calculating the measure of proximity / difference; building a decision rule.

2. LITERATURE REVIEW

2.1 Face Recognition in Videostream of the Urban Video Security System

The rapid development of information technology has led to an increase in computing power, an increase in the volume of data being processed, a general “connectivity”, and an improvement in hardware. These improvements allowed us to optimize many processes in various areas of human life, including those related to information security. Increasingly, the use of the Internet of things in the lives of ordinary citizens can be found, and the embodiment of the “smart” city system is also becoming a reality. One of the most important tasks of the “smart” city system is to increase the security of all urban processes. One of the possible ways to improve the security of urban processes is monitoring and analyzing the data of video streams received from the cameras of the urban video surveillance system.

Within the concept of the Internet of Things (Internet of Things, IoT), one of the most popular directions of development is the concept of a “smart city” (Smart City) [3]. A “smart” city is the provision of modern quality of life through the use of innovative technologies that provide for the economical and environmentally friendly use of urban life-support systems [4]. Thus, the concept of “smart” city includes energy efficiency, “smart” health care, “smart” education, “smart” transport, infrastructure, security, green planet (ecology), communications, including remote access to all types of services and services, “ smart city infrastructure, the introduction of ICT solutions to ensure public and information security, the Internet of Things, the development of wireless communication technologies. The concept of IoT is based on the ubiquity of the Internet, mobile technologies and social media [5].

The task of recognizing faces in a video stream, including in the context of an urban video surveillance system, is related to computer vision tasks. Computer vision allows you to recognize and analyze objects both on static images and in a continuous video stream. The task of face recognition consists of two stages: the stage of face detection, and then its recognition [6]. In order to recognize faces in a video stream, it is possible to use the computer vision API, which allows you to analyze video in almost real time. To do this, you need to extract frames from the video and send these frames to any API calls. Thus, in order to implement an application designed to automate the implementation of permanent monitoring of the video stream, for example, for urban video surveillance systems, it was decided to use the computer vision API from Microsoft Cognitive Service [7-8]. Microsoft Cognitive Services allows you to create "smart" applications that can see, that is, identify, describe and a bat images using image processing algorithms. This service includes many APIs that allow you to perform certain tasks, for

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

example, the Face API recognizes faces in an image, their age and gender, can correlate images and determine the likelihood that two different images represent the face of one person, and can also group images by visual similarity [9].

The application was developed in Microsoft Visual Studio Professional 2015 in C # using Microsoft namespaces. ProjectOxford.Face and Microsoft.ProjectOxford.Face.Contract, allowing to work with video streams as well. At this stage of the study, "surrogate" video streams were studied with good coverage of all participants and mainly with frontal faces. In this regard, the percentage of false recognitions was 0. In the process of recognizing subjects in a video stream, the task was also to additionally recognize the gender and age of an object. The percentage of incorrect recognition of sex is 4, incorrect recognition of age - 75%. In the near future, it is planned to conduct "field" studies in a real organization, for example, within the framework of the access control system. It is possible that the percentage of false positives will increase and additional adjustments or the choice of another method of face recognition will be required [10-11].

Recognizing faces in a video stream is an urgent task, since it can be useful for monitoring the crowd and searching for potential violators, for carrying out search and rescue operations, for counteracting intrusions into protected areas, for authenticating users in the context of payment systems and access control systems. Currently, many different applications and systems for these functions have already been implemented, but the task of face recognition still requires careful study, finding new approaches, as well as improving existing algorithms.

2.2 Face Recognition Approaches

There are several approaches to create a face recognition algorithm.

The empirical approach was used at the very beginning of the development of computer vision. It is based on some of the rules that a person uses to detect a face. For example, the forehead is usually brighter than the central part of the face, which, in turn, is uniform in brightness and color. Another important feature is the presence of parts of the face in the image - the nose, mouth, eyes. To determine the faces, a significant reduction of the image area is made, where the presence of a face is assumed, or perpendicular histograms are constructed. These methods are easy to implement, but they are practically unsuitable in the presence of a large number of foreign objects in the background, several persons in the frame or when changing the angle.

The following approach uses invariant features characteristic of a face image. At its core, as in the previous method, lies the empiricist, that is, the attempt of the system to "think" as a person. The method reveals the characteristic parts of the face, its boundary, change in shape, contrast, etc., combines all these signs and verifies. This method can be used even when turning the head, but with the presence of other faces or a heterogeneous background, recognition becomes impossible.

The following algorithm is the detection of faces using patterns that are specified by the developer. A person appears to be a kind of template or standard, and the purpose of the algorithm is to check each segment for the presence of this pattern, and the check can be made for different angles and scales. Such a system requires a lot of time-consuming calculations.

All modern facial recognition technologies use systems that learn through test images. For training, bases with images containing faces and not containing faces are used. Each fragment of the investigated image is characterized as a feature vector, with which the classifiers (algorithms for determining an object in a frame) determine whether this part of the image is a face or not.

Currently, several dozens of computer methods for face recognition are actively used: methods based on neural networks [12-13]; the main components (own persons) [14-16], based on linear discriminant analysis [6-7]; elastic graph method [17]; a method based on hidden Markov models [18-22]; method based on flexible contour models of the face; method of comparison of standards; optical flux method; methods based on lines of the same intensity; algebraic moments; Karunen-Loeve decomposition; fuzzy logic; Gabor filters, etc. A good overview of these methods can be found in [23].

One of the first developed methods of facial recognition is the method of main components (own faces). Its distinguishing feature is that the main components carry information about the signs of a certain generalized face. Face recognition using linear discriminant analysis is based on the assumption of linear separability of classes (persons) in image space. Neural network methods have a good generalizing ability.

3. FACIAL RECOGNITION PROBLEM

Recognition of objects is an easy task for people, the experiments conducted in [15] showed that even children aged one to three days are able to

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distinguish between remembered faces. Since a person sees the world not as a set of separate parts, our brain must somehow combine various sources of information into useful patterns. The task of automatic face recognition is to isolate these significant features from an image, transforming them into a useful presentation and producing some kind of classification.

The process of face recognition, which is based on geometrical features of the face, is probably the most intuitive approach to the problem of face recognition [24-25]. Experiments on a large data set have shown that, alone, geometric features cannot provide enough information for face recognition.

In this work, we explore face detection and recognition process, describe their mathematical representation and do experiments with facial recognition using Fisherface algorithm.

3.1 Development Overview

The solution as proposed in this research work consists of two parts as recovering low resolution image and the identity of object using the recovered high resolution image.

Image restoration part consists of three subtasks as

1. Converting the low resolution image to digital form
2. Image enhancement and recovery
3. Converting to graphical image from digits.

3.2 Face Detection

At the first stage, the face is detected and localized in the image. At the recognition stage, the image of the face is aligned (geometric and luminance), the calculation of the signs and the direct recognition - the comparison of the calculated signs with the standards embedded in the database. The main difference of all the algorithms presented will be the calculation of signs and the comparison of their aggregates among themselves. Such face detection system types shown in Figure 1.

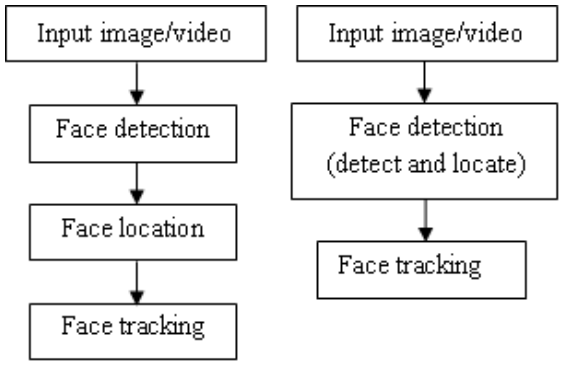

Figure 1: Face detection architecture.

3.3 Face Recognition

There are several different face recognition algorithms as correlation, eigenfaces, linear subspaces and fisherfaces. There were several experiments on identification the effectiveness of those algorithms where the FisherFaces algorithm was chosen as the best one with the lowest error rate in human face recognition. In accordance with experiment results made before it was decided to choose the FisherFaces algorithm for face identification and recognition processes due to its fast and guaranteed recognition of the human. Below we present some information about each of the mentioned methods.

One of the simplest approaches is the correlation method that is the nearest neighbor classifier. According to this approach, an image in the test set is recognized by assigning to it the label of the closest point in the learning set, where distances are measured in the image space. In case of image normalization the procedure is equivalent to choosing the image in the learning set that best fits to the test image. As this approach is considered as the simplest one there can appear several drawbacks such as lighting condition which means that there needs to be a special normalization process in accordance with lighting conditions. Secondly, this type of face checking is computationally expensive. Then, it requires large amount of storage units in order to contain numerous images of one person.

The Eigenfaces algorithm is concentrated on dimensionality reduction in computer vision by using Principal Component Analysis (PCA). The PCA used in Eigenfaces facial recognition method has some drawbacks. The PCA finds a linear combination of features that maximizes the total variance in data. It means that some discriminative information may be lost when throwing components away. For instance, let it be some variance in external source such light. The system that uses the

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PCA do not necessarily contain any discriminative information at all, so the projected images are smeared together and there is no any classification in images.

The third approach is the Linear Subspaces that recognizes that a face is a Lambertian surface. It means that all images of the face lie in a 3D linear subspace of higher-dimension image space, regardless of lighting conditions. With three images of a face under three known and linearly independent lighting sources we can discover the albedo and surface normal of each point on face that allows us to reconstruct the original images under different lighting conditions (Figure 2). As well as other methods this method also has some drawbacks such as there can appear some face variability due to self-shadowing, pivot points and facial expressions. Moreover, this method is computationally expensive and memory intensive.

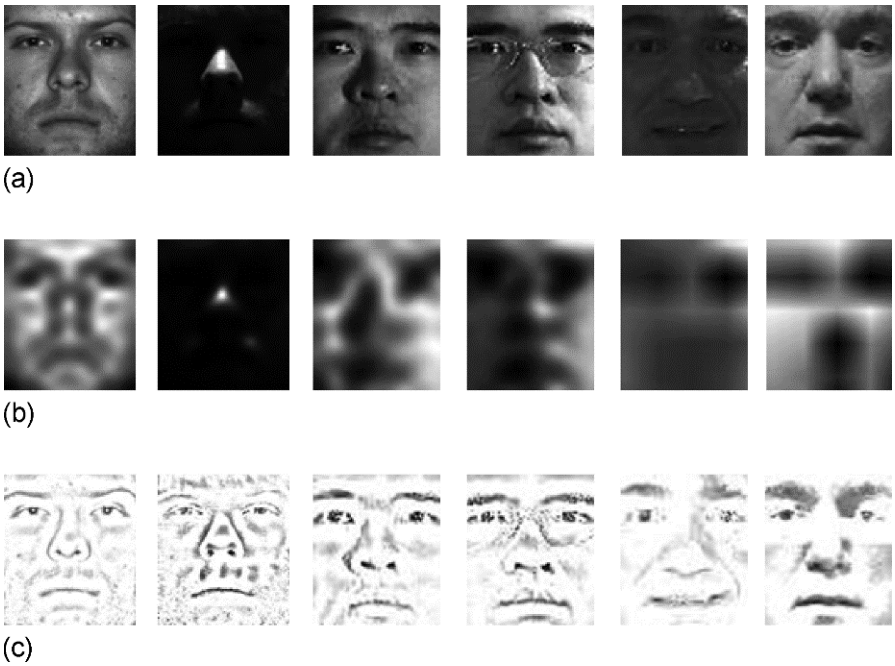

Figure 2: Different subsets of lighting

The last but not the least important face recognition method is fisherfaces algorithm that uses the same technique in regards to the Lambertian surfaces. FisherFaces algorithm is based on Linear Discriminant Analysis that performs the following idea of allocating the same classes together and the classes that are different far away from each other. It is faster than Linear Subspaces and uses less memory. Also, it is more accurate than Correlation and Eigenfaces.

Meanwhile, next test concentrated on different facial expressions of the person (Figure 3). It was tested full heads shots and closely cropped faces. Most of the time faces are taken with glasses, ambient light, three point lights from different angles and five different facial expressions.

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Figure 3: Lighting and Facial Expressions

In accordance with experiment results made before we decided to choose the FisherFaces algorithm for face identification and recognition processes due to its fast and guaranteed recognition of the human. Figure 4 shows the plot that illustrates the error rate depending on the number of principal components.

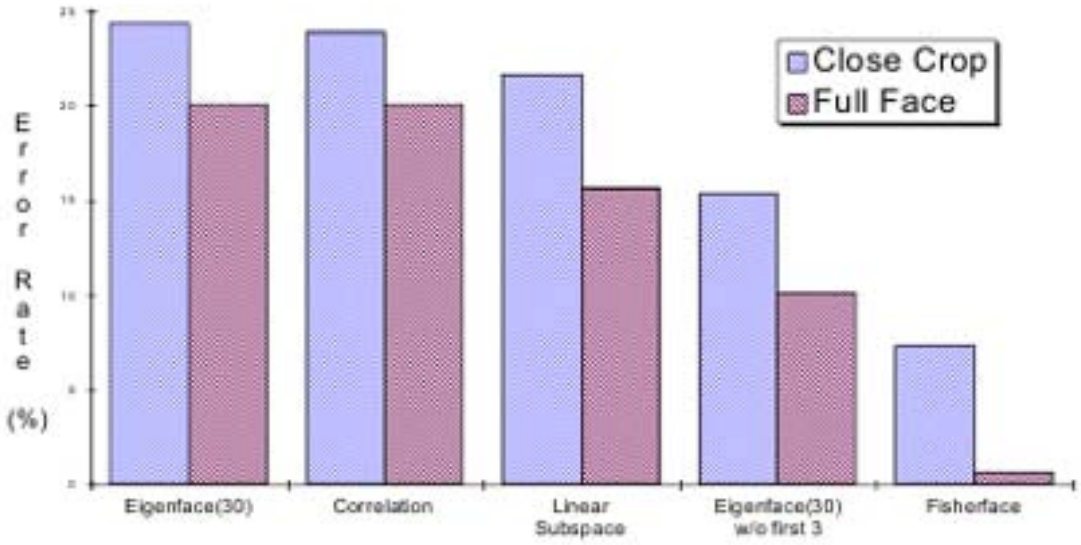

Figure 4: Comparative Analysis of Face Recognition Algorithms

In [26], the authors compare different face recognition algorithms for face detection and recognition. Figure 5 and Figure 6 illustrate training and prediction times of facial recognition by applying different face recognition algorithms [26]. As illustrated in figures, Fisherfaces face recognition algorithm has lowest training time (Figure 5) and lowest predicting time (Figure 6) that is very important to apply in ptz and street cameras of cities.

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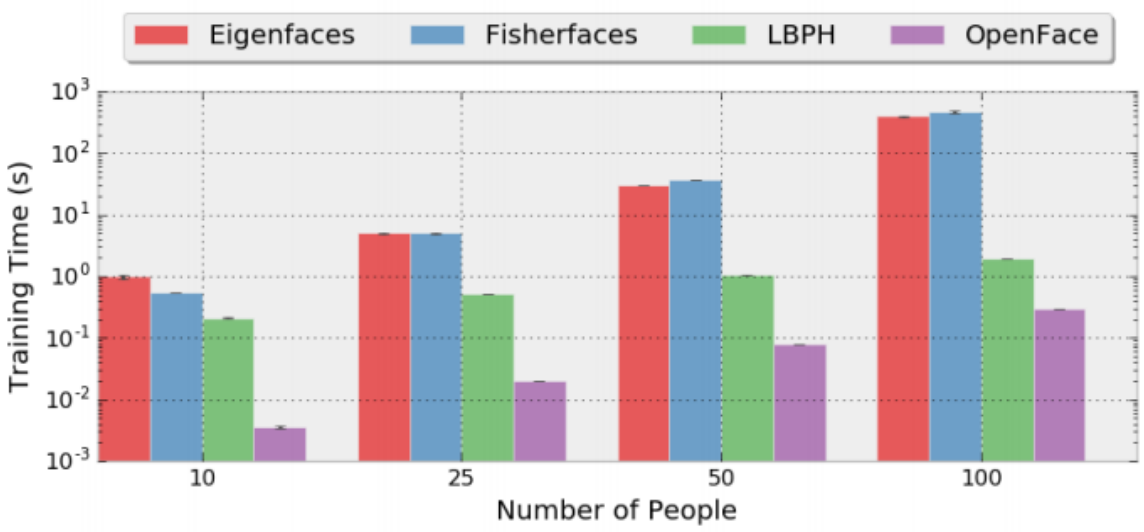

Figure 5: Comparison of training time of different face recognition algorithms

Figure 6: Comparison of predicting time of different face recognition algorithms

As can be seen from the above graphs, the FisherFace method learns the set of projections which perform well over a range of lighting variation, facial expression and even presence of glasses. The algorithmic description of the fisherfaces method is given below:

Let there be a random vector with samples drawn from classes: $X = \{X_1, X_2, ..., X_n\}$

$$X_i = \{X_1, X_2, ..., X_n\} \quad (1)$$

The scatter matrices S_B and S_{W} are calculated as:

$$S_b = \sum_{i=1}^{c} N_i (\mu_i - \mu)(\mu_i - \mu)^T \quad (2)$$

$\sum_{i=1}^{c} \sum_{x_i \in X_i} (x_i - \mu_i)(x_j - \mu_j)^T$, where μ is the total mean:

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$$\mu = \frac{1}{N}\sum_{i=1}^{N} x_i \quad (3)$$

And μ_i is the mean of class $i \in \{1,...,c\}$:

$$\mu_i = \frac{1}{|x_i|}\sum_{x_j \in X_j} x_j \quad (4)$$

Fisher's classic algorithm now looks for a projection, that maximizes the class separability criterion:

$$W_{opt} = \arg\max_W \frac{|W^T S_B W|}{|W^T S_W W|} \quad (5)$$

Following the method of Belhumer, Hespanha and Kriegman, a solution for this optimization problem is given by solving the General Eigenvalue Problem:

$$S_W^{-1} S_B v_i = \lambda_i v_i \quad (6)$$

There's one problem left to solve: The rank of S_W is at most (N-c), with N samples and classes. In pattern recognition problems the number of samples N is almost always smaller than the dimension of the input data (the number of pixels), so the scatter matrix S_W becomes singular. In [BHK97] this was solved by performing a Principal Component Analysis on the data and projecting the samples into the (N-c)-dimensional space. A Linear Discriminate Analysis was then performed on the reduced data, because S_W isn't singular anymore. The optimization problem can then be rewritten as:

$$W_{fld} = \arg\max_W \frac{|W^T W_{pca}^T S_B W_{pca} W|}{|W^T W_{pca}^T S_W W_{pca} W|} \quad (7)$$

The transformation matrix that projects a sample into the (c-1) dimensional space is then given by:

$$W = W_{fld}^T W_{pca}^T \quad (8)$$

Face detection, recognition and gender classification experiments carried out on the basis of facial images database [27]. Sample images are shown in Figure 7. In the formation of the database size of the images and the shooting conditions were the same. They used a 24-bit JPEG format. The base [27] contains pictures of people, male and female, of different nationalities and ages. It reflects changes in a person's appearance: different hairstyles, beards and glasses presence. In preparation for the experiment two training samples were created. The first of them contains 5 images of each person (only 5 × 395 = 1975 images). Second, 10 images of each person's individual learning (a total of 10 × 395 = 3950 images). Also, the dataset has several datasets as Face94, Face95, Face96, and Grimace that the characteristics are listed below.

Figure 7: Sample images of faces

The approach that is used in this method finds out the facial features to discriminate between the persons. The performance of the system that uses the FisherFaces algorithm is highly depends on the input data. The FisherFaces provides a total reconstruction of the projected image by normalizing processing of the image [29-31]. The total set of procedures is given in the Figure 8.

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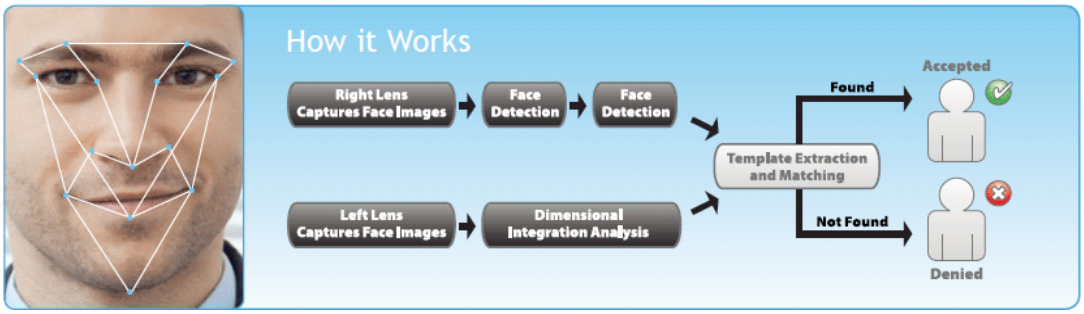

Figure 8: Face verification system in accordance with FisherFace algorithm

As can be seen from the Figure 8, the process of face verification starts with the detection stage, where the image is taken from the camera and is considered as an input data. Then, there goes the normalization process in order to construct the proper image that can be used in FisherFace algorithm. Face normalization actually consists of geometry normalization, background removal and lighting normalization. The images of the face are normalized to a fixed size. If the face was in a wrong angle this angle is determined then is corrected in accordance with rules.

3.4 Methodology

For pattern recognition, classic neural networks were used. As a learning algorithm, the algorithm for back propagation of errors was chosen [32-34].

The neural network is a classic multilayered full-connected perceptron. The sigmoid is chosen as the function of neuron activation as in formula (9):

$$f(x) = \frac{1}{e^{-cx} + 1}. \qquad (9)$$

The number of hidden neurons was chosen to be 1024. The task of network training was solved for each individual subject. For each subject, half of the images were used to train the network, and the remaining half was used for testing. The input of the neural network was the image. The input of each neuron of the input layer was one pixel. The brightness value of each pixel was represented as a real number from the range [0; 1].

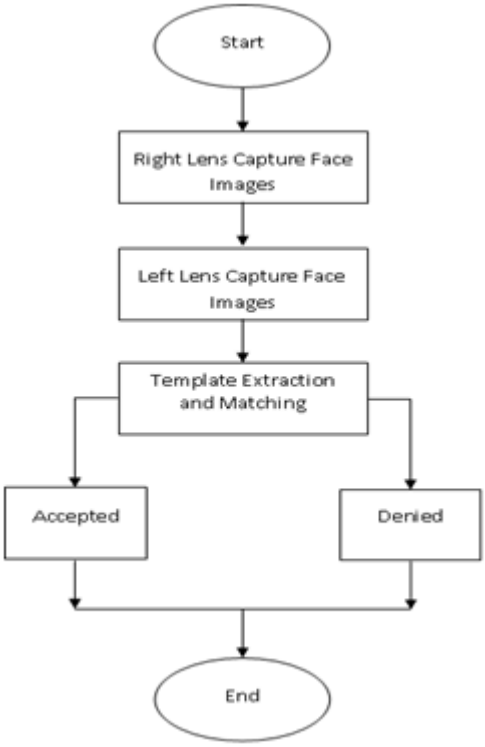

Figure 9: Face detection architecture

The output of the neural network is a variable that takes values from the range [0; 1]. In the event that the output value exceeded 0.85, the conclusion was made that the image submitted to the input was accepted, and if the output value was less than 0.15, it was rejected.

Face recognition system generally involves two main stages as “Face Detection” (Figure 9) and “Face Identification”. First one is face detection, where the system is searching for any faces then takes the image of this face. Following this, image

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processing cleans up the facial image into black-white colors. In our research, face can be detected from several foreshortenings. Implemented results are given in Figure 10.

Figure 10: Face detection from different foreshortenings.

After detecting face, next step will be executed. In this step, feature extraction and verification process will be done. After recognizing the detected and processed facial image is compared to a database of faces in order to decide who that person is, Figure 11.

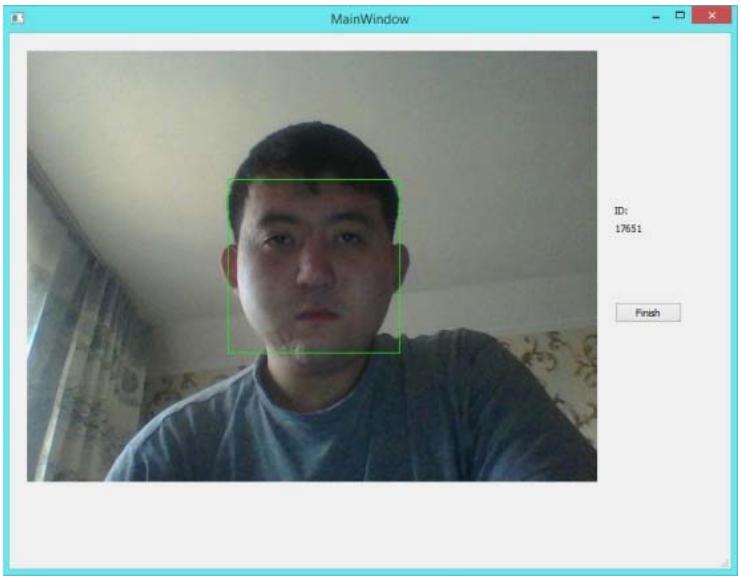

Figure 11: Face recognition.

4. CONCLSION

In this work we applied Fisherface face recognition algorithm for facial recognition problem as a video surveillance system of Smart City application. Fisherface algorithm was chosen because of its practicality and high recognition rate. The mathematical representation of facial recognition problem and Fisherface algorithm were investigated. Experiment results demonstrate face

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

detection and recognition results. Further, we are going to use the proposed system as an application of a Smart City Platform.

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