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Motorola Scholar Awards : 2012-2013

Judges decision on the Motorola Awards

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First Prize

HYBRID MULTIMETER

COLLEGE	**:**	VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE (VJTI), MUMBAI
FACULTY SUPERVISOR	**:**	DR. A. N. CHEERAN
STUDENTS	**:**	JUGAL R. PANCHAL
		PRATIK P. DHAGE
		PRANAV M. PANCHAL
		KUNAL S. DEMBLA

Second Prize

MOTION BASED RECOGNITION IN NEUROSTIMULATOR FOR DIABETIC FOOT PAIN

COLLEGE	:	VEL TECH MULTI TECH DR.RANGARAJAN DR. SAKUNTHALA ENGINEERING COLLEGE, CHENNAI, TAMIL NADU
FACULTY SUPERVISOR	:	PROF. S. SATHISH
STUDENTS	:	M. SRIDEVIDHAKSHAYANI
		N. SHALINI

Third Prize

APPLICATION OF HAND VEIN RECOGNITION FOR BANK LOCKER SECURITY AND TEMPLATE PROTECTION USING FUZZY VAULT

COLLEGE	:	BANNARI AMMAN INSTITUTE OF TECHNOLOGY, ERODE, TAMIL NADU
FACULTY SUPERVISOR	:	MS. V. EVELYN BRINDHA
STUDENTS	:	S. GOKULPRIYA
		T. INDHUJA

19. HYBRID MULTIMETER (H.M.M)

Jugal R. Panchal, Pratik P. Dhage, Pranav M. Panchal, Kunal S. Dembla and Dr. A. N. Cheeran (FS)

Veermata Jijabai Technological Institute (VJTI), Mumbai

Keywords

Oscilloscope, Function Generator, Multimeter, Logic Probe, Cost-efficient, Analog to Digital convertors, Digital to Analog converters.

Problem Definition

To design a low cost portable electronics measuring Instrument. It should be capable enough to provide essential features of 1) Oscilloscope 2) Function generator 3) Digital Multimeter 4) Logic Probe. The device specifications are based on student's usage and to achieve following design features:

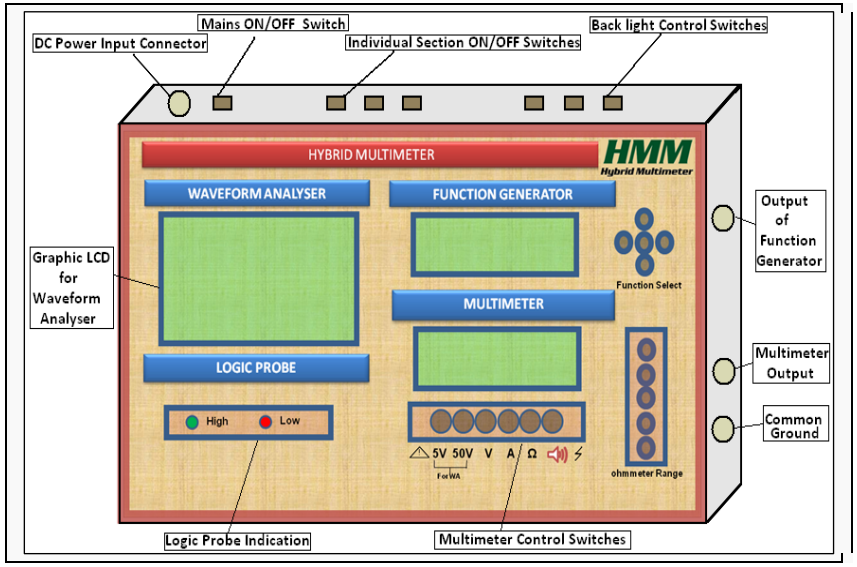

Figure 1: Proposed Model of Hybrid Multimeter

Hybrid Multimeter elements and its working

Hybrid Multimeter can be divided into following sections:

Power supply and over voltage protection circuit: Hybrid Multimeter can be operated with either DC Adapter supply or Battery (+9V/+12V). To prevent the damage to the circuit due to reverse voltage applied across the circuit protection diode is provided in the input of supply unit. Regulator is provided to give the constant Regulated DC voltage to each section of the Hybrid Multimeter. Fuse is provided in the Power supply unit to prevent the damage of the circuit due to short circuit or excess current.

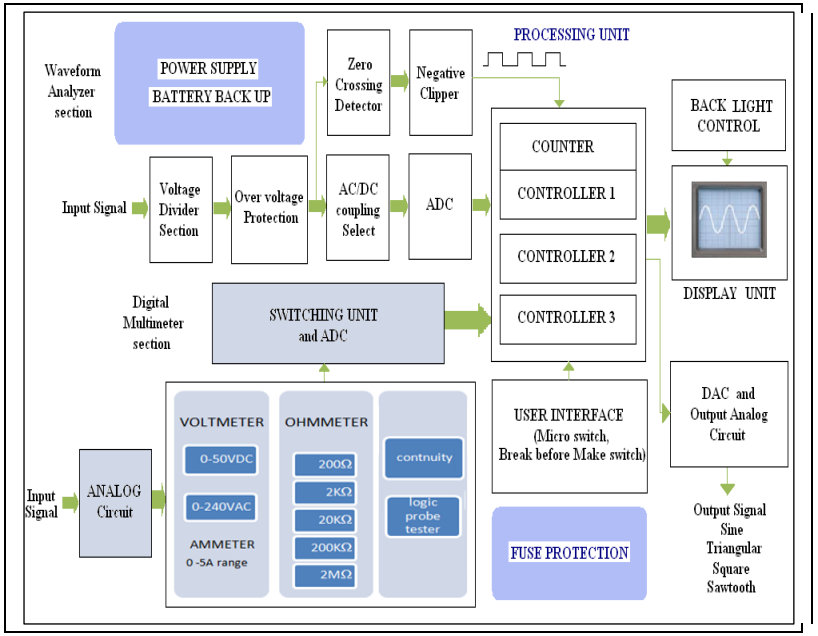

Figure 2: Block Diagram of Hybrid Multimeter

Waveform Analyzer: In Waveform Analyzer input is fed to voltage divider section which will divide the voltage by appropriate factor which is given to the protection and clamper circuit to clamp the negative portion of the input signal. Clamped

output is given to the Analog to Digital converter (ADC) and also to the Zero crossing detector (ZCD). Zero crossing detector will convert input signal into square wave/Trigger pulses these are given to the counter/timer pin of microcontroller unit which will count the no of pluses for predefined time interval i.e. 1 second for calculating frequency. Number of pulses counted in 1 second interval will indicate cycles per second which is nothing but frequency of input signal. Calculated frequency is displayed on graphic LCD. For plotting the nature of input signal clamped input signal is given to ADC which will convert it into digital data. ADC is driven by clock signal; frequency of clock will be equal to sampling rate of ADC. Analog to Digital converter (ADC) being used is having pipeline architecture. Data sampled at the $(N-6)^{th}$ time interval will be available after 6 clock pulses i.e. N^{th} time interval. Because of pipeline architecture of ADC after 6 clock pulses we will get digital data at each rising edge of clock signal. This data available in the output is digital equivalent of analog signal sampled before 6 clock pulses. This digital data is given to the Microcontroller unit which will calibrate the data and calculate various parameters (Frequency, Vmax, Vmin, Vpp). Calibrated data is given to the graphic LCD for displaying the nature. Depending upon the frequency of input signal sampling time of signal can be controlled for higher frequency signal we have to sample data at higher frequency.

Function Generator: In Function Generator user select the appropriate frequency and nature of the signal through micro switches provided on Panel. After selection when user presses the ON button analog signal is available on the output of Digital to Analog converter (DAC). R-2R Ladder DAC is used for converting digital data into analog signal. For each analog output nature corresponding digital data is stored in lookup table. Amplitude of output signal can be varied by adjusting knob provided for variable output.

Multimeter: Multimeter is used to measure various parameters such as resistance, voltage, current and for checking continuity. Switching unit is provided to switch between various units. Switching unit consists of break before make switch to isolate the previous section first before switching to the next section. Output of switching unit is given to the analog circuit for voltage division and resistance measurement. Buzzer with appropriate circuit provide continuity testing feature in Hybrid Multimeter.

Logic Probe: Logic probe will indicate high, low and high impedance state of any node in the circuit. It is TTL/CMOS compatible.

Software Development: MPLAB IDE is used for waveform analyzer programming and WINAVR is used for Function generator and Multimeter programming.

Specification:

Waveform Analyzer:

- Maximum input range: 100V (peak to peak) with 10x probe and 10V (peak to peak) with 1x probe.
- Maximum frequency calculation on display: 64 KHz
- Graphic LCD display unit having resolution of 128 x 64 pixels
- Maximum Frequency of signal which can be displayed: 25 KHz
- Protection against over voltage and current
- Isolation circuit provided to prevent damage to the analog to digital converter (ADC) of system.

Function Generator:

- It can generate Sine, Square, Sawtooth, Triangular and Reverse sawtooth waveforms.
- Two outputs with DC offset and without DC offset available

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- Variable output frequency from 1 Hz-64 KHz with Resolution of 1 Hz
- Simple user interface for changing frequency, nature of waveform and 16 x 2 LCD Display unit
- Maximum output voltage of 5 V (peak to peak)

Multimeter:

- It can measure resistance ,Voltage ,Current, continuity testing
- Resistance range: upto 1 M Ohm
- Voltage range: upto 50 V DC
- Current range: upto 1A DC
- Buzzer provided for continuity testing and easy user interface for selecting various functions

Logic Probe:

- It can indicate TTL/CMOS compatible logic levels
- It can indicate High impedance state.

Problems Encountered:

Clock Jitter Problem in Analog to Digital converter: The ADS805 samples the input signal on the rising edge of the CLK input. Therefore, this edge should have the lowest possible jitter. Initially we were using clock source having jitter problem in the clock signal so there was distortion present in the reconstructed signal on graphic LCD. After giving the clock input from jitter free source we were getting expected distortion free plot of signal.

Impedance Matching Problem: When output of Function generator was given to Passive clamper (input stage of waveform analyzer) there was clipping action in negative portion of input waveform because of mismatch of impedance of ADC Input stage and Function Generator output stage. This Problem was solved by using Active clamper using OP-Amp circuit to provide proper impedance matching.

Loading Effect: Since all sections take power from single battery initially we were using battery with lesser current supply capability so backlight of Display was turning ON properly there was flicker in backlight this problem was solved by battery with appropriate current rating.

Advantages:

- Portable and Cost Effective
- H.M.M operates on 9V/12V battery so no need of mains supply for its operation, Power consumption is less.
- Protection circuits and fuse is also provided if in case voltage /current exceed maximum ratings.
- Simple user interface. It will directly give the readings on application of certain input signal.

Application:

- Engineering Students (majorly required by Electronics, Electrical and Instrumentation Engineers)
- Engineering Institution/College Labs.
- All the electronic passionate people who usually do electronic-hobby Projects.
- Various Research and Development (R & D) Labs.
- Small and Large Scale Industries.

Results:

Following Results are expected from various sections of the Hybrid Multimeter

1. Waveform Analyzer: Display of Input Signal on Graphic LCD and Parameters (Vpp, Frequency)

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Output of function generator is given to the waveform analyzer input to verify the result and various parameters (Frequency). Output of Function generator is 9309 Hz (9.309 KHz) Sine wave and waveform analyzer is also plotting sine wave with appropriate frequency.

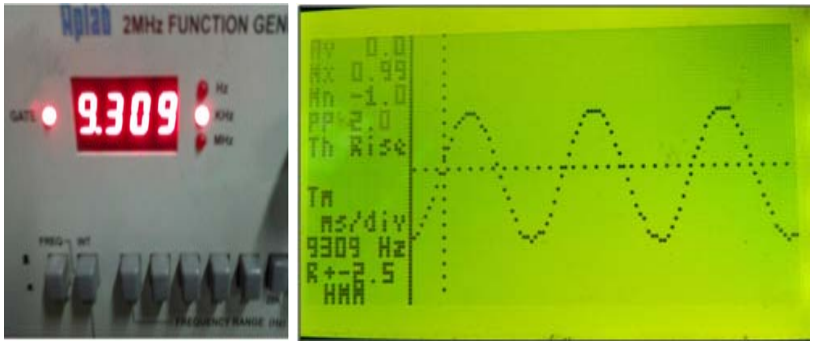

Figure 3: Display of Function generator output on graphic LCD of waveform Analyzer

2. Function Generator: Output of Various signal waveforms (Sine, Square, ramp, Triangular) with variable Frequency.

3. Multimeter: Measurement of Current, Resistance, Voltage and continuity testing

4. Logic probe: Indicated High, Low, High Impedance Sate

   a) Red Light – Logic High

   b) Green Light – Logic Low

   c) Both Lights off – High Impedance State

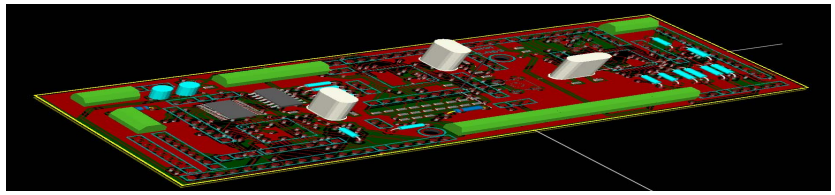

Figure 4: SMD Board layout of Hybrid Multimeter (2 Layers)

Conclusion

This Report reviews the device Hybrid Multimeter which is the upcoming need in electrical engineer's toolbox. This will allow a student to exploit every aspect of its application which will help them develop their technical skills and make testing and troubleshooting easy. The cost of this device is also less than that of the simplest mobile phone. "Hybrid Multimeter (H.M.M)", aims at Developing Cost-effective and Portable Hybrid device which includes features of Digital storage oscilloscope, Function Generator, Multimeter, logic Probe. Today people are demanding miniature devices .This project fulfill this demand to a great extent. For troubleshooting circuit we need various tools. For student it is not affordable to buy costly oscilloscope and other costly testing devices at individual level. Therefore this Project can be a great option as a testing and troubleshooting tool at affordable cost. It also aims to reach all student & technician like calculator to make testing easy, reliable and cheaper.

Future Scope

To make Project more user friendly and Reliable we can introduce the Touch Panel instead of Switches. PC interface can be provided. Storage facility for waveforms and results can be incorporated .Also by using available Technology we can make it Portable. Multiple channels can be provided using analog multiplexer. After interfacing additional circuit higher voltage and frequency can be measured.

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3. MOTION BASED RECOGNITION IN NEUROSTIMULATOR FOR DIABETIC FOOT PAIN

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Keywords

Diabetic foot pain, Diabetic neuropathy, Helen Hayes marker, TVC (Total Video Converter) Virtual Dub, Matlab, Kinematic analysis, Stride analysis,Neurostimulation.

Aim & Objective

To design a system that provides enhanced and better therapy for diabetic foot pain in patients with diabetic neuropathy. The theme of the project is to develop a technique that not only reduces the foot pain in diabetic patients but also involves the gait analysis by which the exact location of pain is detected and stimulation is provided accordingly using neurostimulator. Hence various complications due to constant stimulation is prevented and makes the device more user friendly.

Introduction

We present a novel technique for the better recovery of the diabetic foot pain by using neurostimulator .It is the technique that incorporates the gait (kinematic) analysis and nerve stimulation. Here “Helen Hayes marker set” is designed and fixed in the lower extremity of the leg (sacrum, hip , knee , ankle, heel and toe) and the walking pattern of both diabetic patients and normal subjects are recorded using SLR camera. Using TVC the videos are converted into lossless avi format. Virtual dub is used to convert the videos into segmented frames(one gait cycle) .The hip, knee and ankle data’s are processed using MATLAB coding . Stimulation is provided at exact location of pain in the foot using Neurostimulator according to the angle changes.

Problem Definition

The existing system of neurostimulator gives static nerve stimulation in treating the diabetic foot pain, regardless of progress in recovery. Due to the improper stimulation it causes various side effects if not noticed. By knowing the exact location of pain in the foot and the minimum intensity of stimulation that can be sensed by the patient we can overcome this problem.

The proposed system only reduces the diabetic foot pain but also involves gait(kinematic) analysis. Here the gait parameters and stride variables of the diabetic patients and normal subjects are compared by which the gait change is detected. Thus exact location of pain in the foot is found and stimulation is provided accordingly. This gives enhanced and better therapy for diabetic patients.

Methodology

The gait analysis of the subjects could be done by designing the ‘Helen

Hayes Marker' set.

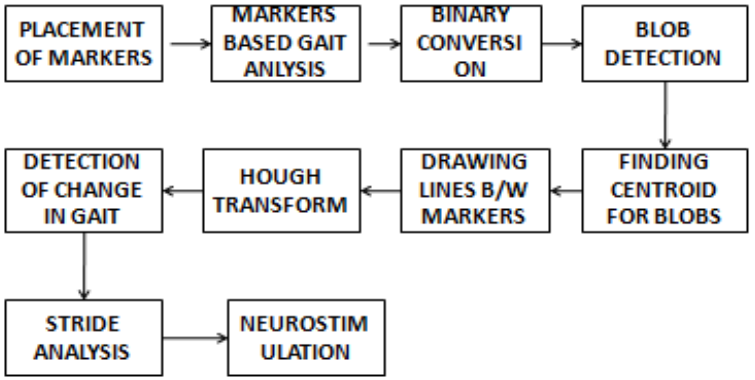
Helen Hayes Markers

Helen Hayes marker set are simplified set of external markers designed for time efficient video analysis of lower extremity kinematics. These marker set are designed using

- 6-LED's,
- 6-two pin socket,
- Connecting wires and
- 9v battery.

They are fixed at the lower extremity of the leg (Sacrum, Hip, Knee, Ankle, Toe, and Heel).These marker set are designed in such a way that their configuration reduces the patient preparation and data acquisition time. patient preparation and data acquisition.

Implementation



Slr camera

High resolution SLR (Single Lens Reflex) camera is used to capture the videos of gait patterns of the diabetic patient and normal subjects. It captures fifty frames per sec and its resolution is 14 megapixels. .The captured videos are in .mov format.

TVC (Total Video Converter)

Total Video Converter (TVC) converts video into various other formats like MP4, 3GP, lossy AVI, lossless AVI and AMR audio. The acquired videos are in (.mov) format and it is converted into lossless (avi) format.

Virtual Dub

Virtual Dub is software used for video capturing and processing utility. It operates on AVI files. The video files are converted into frames. The one gait cycle is extracted from the frames and saved as segmented avi file.

Matlab

MATLAB software is used to analyze data and develop algorithm. The coding is generated for hip, knee ,ankle of the selected frames of the diabetic patient(one gait cycle) and kinematic analysis is done. The frames are segmented and markers are labeled as blobs. The centroid of the blobs are found out and assigned as hip, knee and ankle markers. The lines are drawn between the markers ,Using the Hough transform the lines between the markers are detected from which the angle is calculated.

Stride Analysis

Stride analysis variables are used to detect the change in gait pattern. The ink is applied in the patient's foot and allowed to walk in the white chart. The various parameters were deduced like cadence, velocity, step length, stride length, foot angle, walking base etc..

Neurostimulator

Neurostimulator is a battery operated device that delivers small electrical stimulation to the nerve endings. TENS is one of the simple ,safe and non- invasive method for the chronic pain relief. The maximum life time of the battery is 175 hours at lower frequency. It delivers the continuously varying pulse waveform. TENS consists of two electrodes which are placed with the gel at the location of pain.

Results and Conclusion

The kinematics of different subjects and diabetic patients are compared and gained the results along with the stride analysis. For an normal subject the gait cycle time remains normal .The flexion and extension angle of ankle in sagittal plane is found to be normal in each phases of the gait. The cadence, stance phase duration, step length, stride length, velocity, walking base, foot angle are found to be in accordance with the normal values. For a diabetic patient the gait cycle time is less compared to the normal subject .The flexion and extension angle of ankle in sagittal plane is found to be abnormal in each phases of the gait.

The cadence, stance phase duration, step length, stride length, velocity, walking base, foot angle are found to be abnormal. It was noted that diabetic patients had prolonged stance phase duration compared to normal subjects. These comparisons were made between the individuals of same age group. Double limb support phase is more in diabetic patients in comparison with the normal ones. Kinematics of hip, ankle and knee showed the prominent difference between diabetic patients and normal subjects .From the kinematic analysis the exact location of pain like heel, arch and toe regions are detected and exact stimulation is given using the neurostimulator.

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12. APPLICATION OF HAND VEIN RECOGNITION FOR BANK LOCKER SECURITY AND TEMPLATE PROTECTION USING FUZZY VAULT

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Bannari Amman Institute of Technology, Erode, Tamil Nadu

Keywords

Biometrics, Hand Veins, Minutiae, Secret Key, Fuzzy Vault, Biometric Template Security

Introduction

In banks currently keys are used to unlock lockers which have security issues when keys are stolen or lost. So biometric templates can be used instead of keys. Protecting stored biometric templates is important due to potential misuse of the stolen templates. Formative and usable representation of biometric traits, have not been designed with the objective of their secure storage. Thus if an adversary is able to access a template, he can create a spoof biometric (e.g. gummy finger) from the template and present it to the system. Due to limited liveness detection capability of current biometric readers, the spoof may be accepted by the system providing an illegitimate access to the adversary. Our project aims to improve bank locker security using Hand vein to authenticate an individual, as well as to protect those templates using a cryptographic construct called fuzzy vault.

Objectives

- To enhance the security of bank lockers

  In bank lockers we use keys which is not highly secure, as there are chances of key being stolen or lost or forgotten. So we use dorsal hand vein templates for authentication.

- To protect the stored biometric templates

  Protecting stored biometric templates is important due to potential misuse of the stolen templates. So fuzzy vault technique is used.

Motivation

In bank lockers keys are used at present to open them which is not highly secure, if biometric traits are used for authentication purpose they must be securely stored these two problems motivated us to do this project.

Literature Survey

In the literature survey, papers based on

- Preprocessing the dorsal hand vein patterns (Mohamed Shahin at.al., 2007)
- Extracting features (minutiae points) (Daniel Hartung at.al. 2005)
- Storing the templates securely using cryptographic construct called fuzzy vault (Ari Juels at.al., 2002)
- Classifying and recognizing the patterns (A.M. Badawi at.al., 2006) were studied.

Problem definition

- Protecting stored biometric templates is important due to potential misuse of the stolen templates. If an adversary is able to access a template, he can create a spoof biometric from the template and present it to the system.
- In bank lockers we use keys which is not highly secure, as there are chances of key being stolen or lost or forgotten.

Methodology

The dorsal hand vein dataset has 500 images (5 images of left hand and 5 images of right hand for 50 persons). Among the 5 images 4 images are preprocessed, features are extracted and the templates are securely stored in a database using fuzzy vault. When a person wants to use the bank locker he needs to place his/her hand in the machine provided where the authentication takes place. The authentication is done by verifying the match in the person's fresh hand vein pattern against the pattern stored in the centralized database. Once the authentication is successful the person can use his/her locker. We have implemented this using microcontroller, relay, switch, motor, if the vein is recognized, high signal is sent from the system to the controller via serial port, the controller recognizes the signal and opens the door with the help of motor and relay. If the vein is not recognized low signal is sent and the door remains closed.

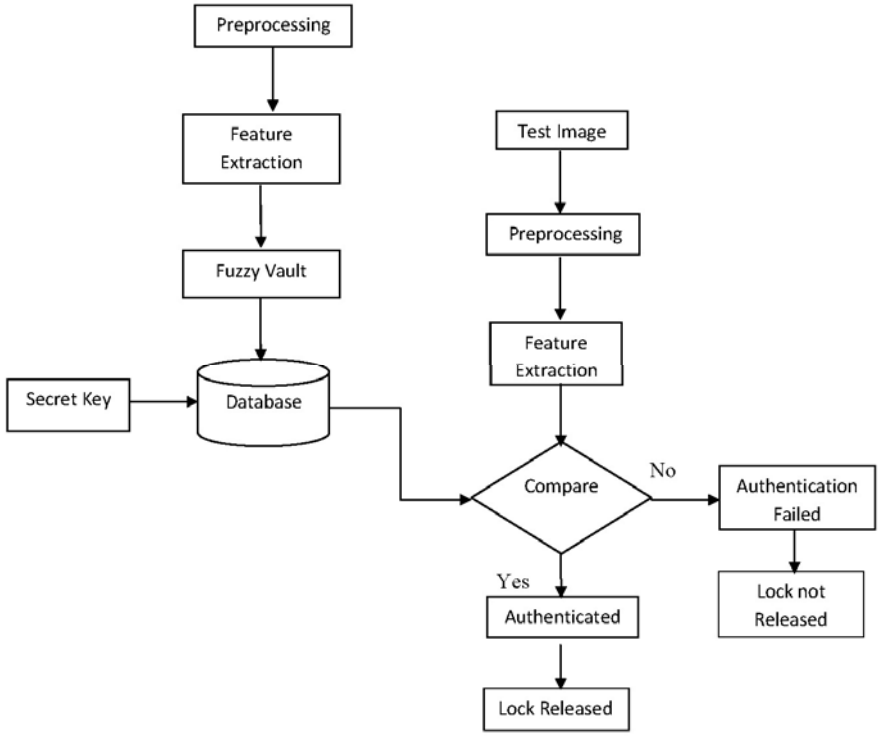

Fig1. Data Flow Diagram

Result & Conclusion

The designed system was tested for verification purpose only over a database collected with the designed system. Dataset for 50 persons of different age and gender of which ten images per person were acquired (five for the right hand and five for the left) in different scenes at different intervals and are independent of each other, i.e. ten images for each person. Verification performance statistical parameters were estimated for the overall system such as: False

Acceptance Rate (FAR), False Rejection Rate (FRR), Efficiency and Receiver Operating Curve (ROC). System testing performance (overall efficiency) was found to be 93.88%. At this maximum efficiency the FAR is 0.03%, and FRR is 7.84%.

Scope For Future Work

To further enhance the security of this system, instead of using a single biometric trait we could use multiple biometric traits.

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