Online ISSN : 0975-4172
Print ISSN : 0975-4350

Global Journal

of Computer Science and Technology: G

Interdisciplinary

Highlights

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Fall Detection by Accelerometer

Discovering Thoughts, Inventing Future

VOLUME 15 ISSUE 3 VERSION 1.0

Global Journal of Computer Science and Technology: G
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Volume 15 Issue 3 (Ver. 1.0)

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Contents of the Issue

Global Journal of Computer Science and Technology: G Interdisciplinary
Volume 15 Issue 3 Version 1.0 Year 2015
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Fall Detection by Accelerometer and Heart Rate Variability Measurement

By Md. Shahiduzzaman
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Abstract- Health monitoring, nowadays become very crucial to tackle huge populations health hazards as technological development is ever upbringing that gives opportunity to help people catering for many health risks in easy way. Nowadays health monitoring is a very crucial research field to address huge population health hazards in effective ways using technologies because availability of human health care personnel are inadequate and costly. Accidental fall is one of the common health risk which leads to severe health injuries, even some cases results in death especially for elderly people (> 65 years old). With the help of wearable sensor system (WSS) many fall detection studies take place to minimize the health injuries; however the studies cannot provide expected efficient result. In this study we have proposed a novel technique to identify successfully fall detection and avoid misclassification using accelerometer and ECG sensors. Analyzing both critical physical movement and mental stress, which are evaluated from the signals of accelerometer and ECG sensors respectively, fall detection process can be greatly enhanced.

Keywords: fall detection, wearable sensor system (WSS), heart rate variability (HRV), accelerometer.

GJCST-G Classification: D.4.8

Strictly as per the compliance and regulations of:

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I. Introduction

In today's busy and expensive world everyone is so tied up with their daily works that most of the times no family members can be with the elder people of the family 24/7. Also, external help is not affordable for everyone. Again, there are cases where elder people are living in their home all alone independently. In all of the above cases, the common problem is lack of continuous health monitoring of elderly people living alone. Public health care organizations are working to provide affordable health monitoring systems for the elderly. They are using different types of sensors, cameras in every possible location inside the house and collecting data through them. These systems also analyze the data and generate alerts in case of emergency situations.

Scanaill et. al. [4] evaluated the mobility of elderly people using smart homes and different sensors like pressure sensors, pressure mat, smart tiles, sound sensors, infrared sensors etc. to detect any severe health issues beforehand. They also used wearable sensors like pedometers, accelerometers etc. and also combination systems for health monitoring. Their telemonitoring system regularly checked the data from different mobility sensors and depicted if a person is healthy and can live independently or gradually becoming sick or needed external health care. They got good results in most of the cases. In [2], a speech and face recognition system is used to monitor elderly people. Different cameras installed in different rooms captures the facial expressions and movements and the app of a handheld device records voice. According to the video and speech stored in the cloud, a caregiver generates alerts or call the person if necessary. There are other systems like this which cover the overall health monitoring of elderly people. In this paper, we are concentrating on a particular problem for the ageing people. From the statistics, we get an alarming picture of elderly people suddenly falling for different health issues. It says that at least once in a year, almost 30% of the ageing people tends to fall and 75% of these falls are deadly [15]. Even if the person survives, the experience leaves them in depression. We tried a new approach for fall detection which can predict falling from monitoring the movement of the person and sensing the stress level from heart rate simultaneously for early fall detection. Here, we proposed a novel technique by combining responses from accelerometer sensor and heart rate variability sensor to identify fall more precisely over some identical movement like sit down, lie down on bed and take things from ground etc. Web cam based sensor system have high computation and storage constraints. Moreover there are some cases where privacy may be ignored. In addition, our proposed system gives the freedom to move anywhere regardless only a closed area.

The paper is organized as follows: section 2 discusses about some related works in this field, section 3 describes our proposed method and the steps of our working process, section 4 analyzes the experimental results, section 5 discusses the summary of the complete system and section 6 concludes the paper with some possible future works.

II. Related Works

Several works, projects and applications on fall detection are already out there. Each of them tried some new technique or merged some different applications together to get better results. In [3], a Time-Of-Flight 3D camera which could automatically change orientation and position was used to perceive four specific postures

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for fall detection. They calculated the distance between the floor and the centroid of the human and the time duration of any inactivity in that position and hence detected the fall events. Image based sensors were also used in [5]. They installed a digital camera on ceiling and evaluated five postures of 21 people to detect fall early. The accuracy of the system was 77% and only 5% false alarms were generated. A single USB webcam placed on the top corner of the room was used in [8] for fall detection. They mainly tracked the head of the person and monitored the movement and velocity of the head to detect fall. 19 images were used to test the system (9 fall sequences and 10 normal activities) and it could detect 2 falls out of 3 falling situations.

As we are working with motion and HRV sensors, some related works based on only these two sensors are described below.

a) Motion Sensors

Ilievet. al.[1] used a 3D accelerometer to detect and store the motion of the elderly people. The sensors were placed at different rooms of the house and the signals from the sensors were stored in a laptop to analyze further. They analyzed signals of different movements like sitting, walking, sleeping and other possible postures and generated a formula for fall detection. They built an accurate, extremely useful and simple real time system with no false fall detection. Bourke et. al. [6] used tri-axial accelerometer sensors on trunk and thigh of elderly people to detect fall and differentiate them from day to day activities. They used eight types of falls including forward falls, backward falls and lateral falls left and right, performed with legs straight and flexed and used a dataset with 480 types of movements to get perfect results. Their algorithm used upper and lower fall thresholds and they found that the sensor mounted on the trunk gave the best result with almost 100% accuracy. In [7], they tried the same thing with a bi-axial gyroscope based sensor array mounted on the trunk for fall detection. For the same dataset, the result gave 100% accuracy to distinguish between actual fall and regular activities. In [9], a single waist mounted tri-axial accelerometer was used to detect fall events with only 1.03% false alarm rate. They used SVM classifier with up to fifth-order cumulant features to correctly classify fall events and achieved optimization level higher than 95% with second and fifth-order cumulant. SVM was also used in [10] where a wireless gait analysis sensor was worn by the subjects at T4 or waist and experimented for some intentional fall events.

They got 98.7-98.8% accuracy. They extracted six features from the acceleration and angular velocity of the subject and after transmitting the data wirelessly to a computer, they classified them to check for a fall. Accelerometer based fall detection was also used in [11] where 12 out of 15 falls were detected accurately in a real-life situation with 80% sensitivity and .025 false alarm rate. They monitored 16 elderly people for 15500 hours for their experiments. Accelerometer was used also in [12] integrated in a smart home environment via Bluetooth. The elderly people were to wear a small, cheap and low power consuming accelerometer which can generate alerts after fall detection in a smart home environment. A wrist worn wearable device containing an accelerometer was used to detect fall in [13]. But they took a different approach for their fall detection algorithm and classification algorithm of daily life activities. Their power competent algorithms were implemented in a simple 8-bit microcontroller unit and as they used an interrupt-based system which was activated only after getting an interrupt signal from the accelerometer, they had to work with less data, hence the system was more efficient. 36 humans were tested for total 702 types of movements in a laboratory setting for fall detection in [14]. Their wearable device consist of accelerometer and gyroscope was wireless and worn on chest. Their algorithm presented specificity of 96.2% and specificity of 96.3% for the dataset which was divided into two parts, for development of the system and for assessment. The use of gyroscope improved the results of fall detection than using only an accelerometer.

b) HRV Sensors

At the time of critical moment such as any kind of accident which creates acute mental stress in human nervous system, elder persons face unwanted fall unlike normal movement, which create a physiological stress in their nervous system. The mental stress can be identified by measuring heart rate variability (HRV). HRV refers to the beat to beat alteration of heart rate. There are two types of HRV, High HRV which refers a good adaptability of autonomous nervous system or in other word a good mental health and Low HRV that represent abnormal physiological condition and mental stress [18].

Using Electrocardiogram (ECG) biosensor we can trace the electrical signal in the heart [17]. The length between two consecutive heart beat in the signal is called cycle length. In HRV analysis, cycle length variability or in other term "RR variability" is being used [19–23]. R is a point corresponding to the peak of the QRS complex of the ECG wave; and RR is the interval between successive Rs. The P wave represents atrial depolarization, the QRS represents ventricular depolarization, and the T wave reflects the rapid repolarization of the ventricles.

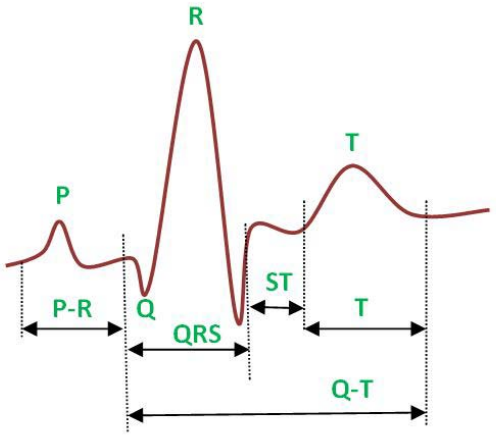

Fig.1: ECG signal

III. Proposed Method

The method we are proposing is very simple and easy to implement. It needs an accelerometer and a heart rate variability sensor. The algorithm takes the movements of the person from the accelerometer and the heart rates from the HRV sensor as inputs. Then it analyzes both the signals separately to check any abnormality. It shows alerts for fall detection only if it gets abnormal results from both the sensors. Parameters of our proposed sensor as follows:

Table 1: Sensor properties

sensor	parameters
Accelerometer	Acceleration of X, Y and Z axis, Total sum of acceleration Acc, LFT, UFT
ECG	Mean RR, SDNN, pNN50, LF, HF, LF/HF ratio

a) Algorithm: 1

1. Receive signal from accelerometer and heart rate variability sensor.
2. Analyze these signal individually.
3. If signal from accelerometer find fall like response is true and signal from heart rate variability sensor response for critical stress in mind is also true **then,** Identify a true fall detection when both censor response are true.
4. Identify a false fall detection when any one of the two sensors response is false.

b) Movement Detection with Accelerometer

The acceleration of the three dimensional axis are the key parameters to define critical state during fall occurs [16]. Following steps are designed to define fall state identification:

1. Collect tri-axial acceleration Ax ,Ay and Az from X, Y and Z dimension respectively.
2. Calculate total sum of acceleration vector, Acc as :

$$\text{Acc} = \sqrt{Ax^2 + Ay^2 + Az^2}$$

3. Set lower fall threshold (LFT) at the local minima for the Acc recorded data, which is known as signal lower peak value.
4. Set upper fall threshold (LFT) at the local maxima for the Acc recorded data , which is known as signal upper peak value.
5. When Acc <= LFT and Acc >= UFT then Fall state identified.

c) Stress Detection with HRV Sensor

We have used Time domain analysis for HRV which is simple and less sensitive to noise and signal artifacts than frequency domain method. Time domain analysis can be directly applied onto the successive RR interval values. Time domain parameters mean R-R (MRR), mean HR and Standard deviation of all NN intervals (SDNN) are mostly associated with the overall variability of the R-R intervals. MRR and SDNN is are calculated as follows [16]:

$$\text{MRR} = \acute{I} = \frac{1}{N-1}\sum_{n=2}^{N} I(n)$$

$$\text{MDNN} = \sqrt{\frac{1}{N-1}\sum_{n=2}^{N}\left[I(n) - \acute{I}\right]^2}$$

Here, N indicates the total number of successive RR intervals of heart beats. The number of adjacent NN intervals differing by more than 50 m sec (NN50count) is calculated. The percentage of differences between adjacent NN intervals differing by more than 50 m sec (pNN50%) is calculated as:

$$\text{pNN50} = \frac{NN50}{N-1} \times 100$$

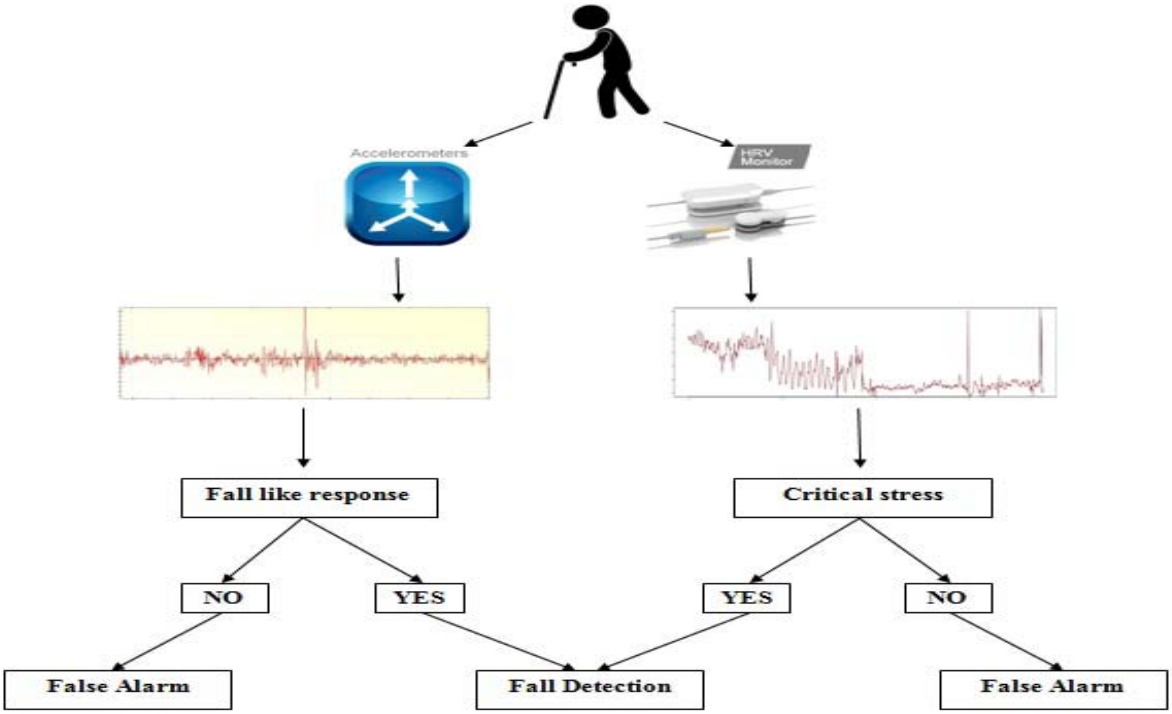

Fig. 2 : Fall detection algorithm

d) Algorithm: 2

1. Signal accusation
a. Receive ECG signal
2. Pre-processing
a. Filter signal for external noises baseline wander and high frequencies are removed by using a second order Butterworth filter with passband 0.5-10 Hz.

$$s[n] = \text{Butterworth}(PTG[n], 0.5 - 10Hz)$$

b. Use differentiator the derivative method allows more accurate recognition of the inflection points and easier interpretation of the original wave.
c. squaring the signal to amplify The signal squaring is taken for positive results and emphasizing of large differences
3. Feature extraction
a. peak points are identified by comparing two moving windows
4. Result compared with threshold value,
a. apply locally adaptive thresh holding using Pan and Tompkin's method
b. evaluate possible QRS complex range
c. discard out of range data
5. Register beat
a. QRS complex candidate selection

IV. Experimental Results

By analyzing different possible movement for elderly people where we have taken most 4 types movement on 1) daily activities like walking, sitting in normal speed, 2) Fall like activity like quickly lay down on the bed or sit down on chair in normal situation, 3) sit down or lay down on bed in normal speed while feeling stress and 4) Quick fall down while feeling stress.

There were total 50 people attendants in our experiment including 30 elderly people (age 60-80) and 20 volunteers (age 20-40). We have collected 400 samples to examine our system.

Table 2 : The Sample List

Sample categories	1	2	3	4
Total samples	100	100	100	100

Table 3 : The experiment result

Sample categories	1	2	3	4
correct	100	98	98	96
incorrect	0	2	2	4
Percentage of correctness	100.0	98.0	98.0	96.0

V. Conclusion

Wearable Sensor System is a near optimal technique to identify fall detection in low cost which maintains privacy issues for individuals. Utilizing both movement sensor such as accelerometer and heart rate variability sensor like ECG, we can implement the credible and efficient fall detection for aged people. In future we will develop to a community alert system for a

lonely people when a fall detection identified to take medical care immediately.

References Références Referencias

1. Ivo T. Iliev ,Serafim D. Tabakov , Ivan A. Dotsinsky, Automatic fall detection of elderly living alone at home environment, Global Journal of Medical research Volume 11 Issue 4 Version 1.0, pp 49-54, December 2011.
2. M. Shamim Hossain, Ghulam Muhammad, Cloud-Assisted Speech and Face Recognition Framework for Health Monitoring, Mobile Networks and Applications 2015.
3. G. Diraco, A. Leone, P. Siciliano, An Active Vision System for Fall Detection and Posture Recognition in Elderly Healthcare, Design, Automation & Test in Europe Conference & Exhibition (DATE), March 2010, pp. 1536 - 1541.
4. Cliodhna N´I Scanaill, Sheila Carew, Pierre Barralon,NorbertNoury, Declan Lyons, and Gerard M. Lyons, A Review of Approaches to Mobility Telemonitoring of the Elderly in Their Living Environment, Annals of Biomedical Engineering, Vol. 34, No. 4, April 2006, pp. 547–563.
5. Tracy Lee and Alex Mihailidis, An intelligent emergency response system: preliminary development and testing of automated fall detection, Journal of Telemedicine and Telecare, February 2005, pp. 194-198.
6. A.K. Bourke, J.V. O'Brien, G.M. Lyons, Evaluation of a threshold-based tri-axial accelerometer fall detection algorithm, Gait & Posture 26 , 2007, pp.194–199.
7. A.K. Bourke, G.M. Lyons, A threshold-based fall-detection algorithm using a bi-axial gyroscope sensor, Medical Engineering & Physics 30 , 2008, pp. 84-90.
8. Caroline Rougier, Jean Meunier, Alain St-Arnaud and Jacqueline Rousseau, Monocular 3D Head Tracking to Detect Falls of Elderly People, Proceedings of the 28th IEEE EMBS Annual International Conference New York City, USA, Aug 30-Sept 3, 2006, pp. 6384-6387.
9. Satya Samyukta Kambhampati, Vishal Singh, M. Sabarimalai Manikandan, Barathram Ramkumar, Unified framework for triaxial accelerometer-based fall event detection and classification using cumulants and hierarchical decision tree classifier, Healthcare Technology Letters, Volume2, Issue4, August2015, p.101–107.
10. Shibuya N., Nukala B.T. , Rodriguez A.I. ; Tsay, J. ; Nguyen T.Q. , Zupancic S. , Lie D.Y.C., A real-time fall detection system using a wearable gait analysis sensor and a Support Vector Machine (SVM) classifier, Eighth International Conference on Mobile Computing and Ubiquitous Networking (ICMU), 20-22 Jan. 2015, p. 66 - 67.
11. Kangas M., Korpelainen R., Vikman I., Nyberg L., Jämsä T, Sensitivity and False Alarm Rate of a Fall Sensor in Long-Term Fall Detection in the Elderly, International Journal of Experimental, Clinical, Behavioural and Technological Gerontology, Vol. 61, No. 1, 2015,
12. Dennis Sprute , AljoschaPörtner, Alexander Weinitschke, Matthias König, Smart Fall: Accelerometer-Based Fall Detection in a Smart Home Environment, Proceedings of 13th International Conference on Smart Homes and Health Telematics, ICOST 2015, Geneva, Switzerland, June 10-12, 2015,pp 194-205.
13. Jian Yuan, KokKiong Tan, Tong Heng Lee , Koh, G.C.H., Power-Efficient Interrupt-Driven Algorithms for Fall Detection and Classification of Activities of Daily Living, Sensors Journal, IEEE (Volume:15 , Issue: 3), pp 1377 - 1387.
14. Quoc T. Huynh, Uyen D. Nguyen, Lucia B. Irazabal, NazaninGhassemian, and Binh Q. Tran, Optimization of an Accelerometer and Gyroscope-Based Fall Detection Algorithm, Journal of Sensors Volume 2015 (2015), Article ID 452078, 8 pages.
15. E. Duthie, "Falls," Medical Clinics of NorthAmerica, vol. 73, 1989, pp. 1321–1335.
16. Wang HM, Huang SC: SDNN/RMSSD as a surrogate for LF/HF: a revised investigation.Model and SimulEngin 2012.
17. C. W. Lin, J. S. Wang, and P. C. Chung, "Mining physiological conditions from heart rate variability analysis," IEEE Computational Intelligence Magazine, vol. 5, no. 1, pp. 50–58, 2010.
18. S.C. Segerstrom and G.E. Miller, "Psychological Stress and the Human Immune System: A Meta-Analytic Study of 30 Years of Inquiry", Psychological Bulletin, 2004
19. J. Pan and W. J. Tompkins, "A real-time QRS detection algorithm," IEEE Transactions on Biomedical Engineering, vol. 32, no. 3, pp. 230–236, 1985.
20. J. Mateo and P. Laguna, "Analysis of heart rate variability in the presence of ectopic beats using the heart timing signal," IEEE Transactions on Biomedical Engineering, vol. 50, no. 3, pp. 334–343, 2003.
21. S. McKinley and M. Levine, "Cubic spline interpolation,"http://online.redwoods.cc.ca.us/instruct/darnold/laproj/Fall98/SkyMeg/proj.pdf".
22. M. P. Tarvainen, P. O. Ranta-aho, and P. A. Karjalainen, "An advanced detrending method with application to HRV analysis," IEEE Transactions on Biomedical Engineering, vol. 49, no. 2, pp. 172–175, 2002.

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Global Journal of Computer Science and Technology: G Interdisciplinary
Volume 15 Issue 3 Version 1.0 Year 2015
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

A Survey on Fault Tolerant Multipath Routing Protocols in Wireless Sensor Networks

By Ms. Balwinder Kaur Dhir
Punjab Institute of Technology Kapurthala University, India

Abstrac - Wireless Sensor Networks (WSNs) consists of large number of energy constrained sensor nodes that are randomly deployed. Sensor nodes have the ability to sense and send data towards the base station (BS). Sensor nodes require large amount of energy for data transmission. So while transmission, some nodes die because of energy depletion. In this case, chance of data loss increases. In order to reduce the data loss fault tolerance technique are used. To provide fault tolerance some Multipath Routing Protocol (MRP) are proposed, which can be classified in two ways i.e. alternative path routing or retransmission and concurrent routing protocol or replication. In MRP, multiple paths are used to send data from source to destination, where if one node fails during data transmission, another node can be used to transmit the same data to the destination by following other optimal path. In this paper we survey various multipath routing protocols along with their fault tolerance schemes and compare each protocol with various parameters.

Keywords: WSN, fault tolerance, multipath routing protocol, retransmission, replication.

GJCST-G Classification: I.2.9 C.2.1

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A Survey on Fault Tolerant Multipath Routing Protocols in Wireless Sensor Networks

Ms. Balwinder Kaur Dhir

Abstract- Wireless Sensor Networks (WSNs) consists of large number of energy constrained sensor nodes that are randomly deployed. Sensor nodes have the ability to sense and send data towards the base station (BS). Sensor nodes require large amount of energy for data transmission. So while transmission, some nodes die because of energy depletion. In this case, chance of data loss increases. In order to reduce the data loss fault tolerance technique are used. To provide fault tolerance some Multipath Routing Protocol (MRP) are proposed, which can be classified in two ways i.e. alternative path routing or retransmission and concurrent routing protocol or replication. In MRP, multiple paths are used to send data from source to destination, where if one node fails during data transmission, another node can be used to transmit the same data to the destination by following other optimal path. In this paper we survey various multipath routing protocols along with their fault tolerance schemes and compare each protocol with various parameters.

Keywords: WSN, fault tolerance, multipath routing protocol, retransmission, replication.

I. Introduction

Wireless sensor networks have currently research attention due to its large area of significance that are not under the human control. It is a wireless network comprising of huge amount of static or mobile sensors. Inside a WSN, the sensors autonomously associate to sense, collect, process data and transmit those sensed data to some specific data processing centers. These characteristics along with self-organization and self-configuration capabilities of sensor nodes make WSNs very promising for applications in many different fields. WSNs are interesting from an engineer perspective, because they present serious key design challenges. Sensor nodes are battery driven and hence operate with a limited energy resource. In large and dense sensor networks it is not feasible to replace batteries when a sensor node is down. In practice, it will be necessary in many applications to provide guarantee that a network with unattended wireless sensors can remain operational without any replacements for several years. For instance, in forest and unreachable areas, such as the Antarctica or the deepest zones of the Atlantic Ocean, sensors can be easily deployed in order to form a large-dense sensor network and sense seismic waves, temperature or other parameters as well. In these scenarios, the replacement of the battery of a sensor node would be highly expensive.

Nodes in a wireless sensor network has to be able to configure their own network topology; localize, synchronize, and calibrate themselves; coordinate inter-node communication; and determine other important operating parameters. They also must be able to adapt themselves to the environmental conditions and unexpected situations in order to keep the performance negotiated and have a robust network. After deployment it is common in wireless sensor networks having topological changes due to changes in position of sensor nodes, ability to reach, available energy, and device failure or energy depletion.

The routing protocol cannot be directly applied due to existing design challenges in WSN like energy consumption, node deployment, Quality of services (QoS) data aggregation and node mobility in the ad hoc network or cellular network. For example if we want to deployed the large number of sensor nodes in WSN, then it will not possible to build a global addressing scheme as the overhead of ID maintenance is high. We have already discussed about the sensor nodes that sensor nodes depends upon energy for its activities, thus if one node fails or link breaks due to its limited battery lifetime, then it will affect the entire network, hence a careful resource management is required. To provide fault tolerance the routing protocol should be designed. Due to fault tolerance mechanism the data loss should be reduced, and it will also increase the reliability of the network which is most important. It is essential to specify the contrast between faults, errors, and failures. Various definitions are used about these terms. From survey

"A fault is any kind of imperfection that leads to an error."

"An error refers to mistaken (undefined) system state. Such a state may lead to a failure".

"A failure is the disclosure of an error, which occurs when the system drifts from its statement and cannot deliver its purposive functionality".

In this paper also focused on the metrics to enhance the reliability of WSN by using multipath routing. Here in this paper the existing technique of fault recovery also classified in to retransmission and replication. In our survey we also describe the

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advantages of using multipath routing protocol along with their fault tolerant mechanism to increase the WSN reliability issues. The rest of the paper is organized as follows. Section II. Focus on different mechanisms to provide fault tolerance. Further, section III provides the work related to fault tolerant routing techniques. Finally section IV concludes this paper.

II. Mechanism to Provide Fault Tolerance

Fault tolerance ensures that a system must be work in the presence of fault without any interruption. Fault tolerance increases the availability, reliability and consequent dependability of the system. Here are many approaches for fault tolerance is there but the most popular approach is multipath routing. In multipath routing there are multipath between source nodes and the sink have the highest energy to consume and traffic generation. There are some additional benefits of multipath routing i.e. bandwidth aggregation and load balancing.

We can classify the routing protocol for WSN [1,2] in to groups on the basis of find the path, proactive routing where computing and maintenance of path should be done in advance and store in the routing table, reactive routing where path paths are created and demanded..

There are two mechanisms [6] used to create multiple paths:

- Disjoint multipath
- Braided multipath

In *Disjoint multipath* a number of additional multipaths are created which are joined to primary path by node/link disjoint and with other additional path. Thus if failure arise at any instant of time that does not affect he additional path. The additional path consumes more energy than primary path because they have longer latency. So if this multipath scheme is used in the network with K node/link disjoint routes from node to sink that can tolerate at least K-1 network failure.

In *Braided multipath* an additional path is created for each node, in primary path that doesn't include that node.

This additional path are not much more expensive then the primary path, In case of latency and overhead. Here if all of the nodes on primary path fails then additional path can e used.

Multipath Routing in WSN

Due to the high potent of wireless links and limited capacity of a multi-hop path [5] and the [3,9], single-path routing approach is impossible to provide remarkable high data rate transmission in WSN. At present, the multipath routing approach is employ at high level as one of the possible solution with limited sources.

Multipath routing can be divided in two ways:

- Alternate path routing or Retransmission
- Concurrent path routing or Replication

a) Alternate path routing or Retransmission

Alternate path routing or Retransmission is one of the most popular mechanism, if the data packet is not transmit to sink successfully, then the source node retransmit the data packet on multiple path by using the minimum hope count and minimum energy consumption depending upon the requirement of network. In the process a source node send data packet to sink and if the data packet successfully received by the sink then the sink send the acknowledgement back to source node as reply. If sink node does not send the acknowledgement and sender does not receive the acknowledgement before time out, it means that data packet is not reached at the sink, and sender retransmit the data packet. In WSN packet loss rate is high then other networks. So the retransmission is very popular mechanism.

But there are some drawbacks of this method i.e. It increases the traffic on network. Delivery delay is due to acknowledgement message. Large memory space is needed to buffer the data packet until the sensor does not receive the acknowledgement.

Objectives:

1. To provide fault tolerant routing.
2. To reduce the frequency of route rediscovery process.

b) Concurrent path routing or Replication

Concurrent path routing or Replication means the redundancy. To introduce the redundancy into delivery of the data packet [8] is another mechanism that s used in fault tolerance routing protocol in WSN. By this mechanism to ensure the delivery of original data packet to sink, transmit multiple copies of the original data packet at the multiple path in order to recover from the path failure this mechanism have major drawbacks, i.e. it introduce

Table 1 : Table of The Existing Multipath Routing Protocols Based on The Historic Design

Year	Alternate Path routing or Retransmission	Concurrent Path Routing or Replication
2000	Directed Diffusion[4]	-
2001	Highly Resilient, Energy Efficient Multipath Routing Protocol[7]	-
2003	-	Rein for M[20,10]
2005	-	N-to-1 multipath routing[11]
2006	-	H-SPREAD[12] MMSPEED[13]
2007	-	MCMP[14]
2008	-	ECMP[15]
2013	Informer homed routing[21]	-

high overhead, because maintenance of path state, until the packet does not reach at the sink. Furter Concurrent path routing it can divided in to two ways:

- For reliable data transmission
- For efficient resource utilization

Objectives:

1. To improve the data transmission reliability.
2. Congestion control.
3. Bandwidth aggregation.

Table 2 : Summery of the Multipath Routing Protocols based Upon Alternative Path Rouing

Features / Protocol	Route maintenance	Type of path	Path choose by	Performance parameter
DD[4]	When all active path failed then discover the new path	Partially disjoint	Sink	Data transmission delay and packet loss ratio caused by path failure
IHR [21]	It have a backup route which activate when primary path failed	Moderately disjoint	Source node choose initially	Path maintenance and network lifetime
HREEMRP [7]	When primary path fails then nodes send data packets by another path	Moderately disjoint	Source and interme-diate node	Route discovery and path maintenance overhead due to flooding

Directed Diffusion (DD) [4] is supposed to be as one of the important routing protocol. There are many other routing protocol that that are act as directed diffusion protocol or use the same concept. The main idea of this protocol is that interest message is broadcast by sink that cyclically refresh along the network, a query is contained in this packet called information that the sink wants to request from the sensor nodes. When interest packet is received by the nodes, all nodes existing in the network catch the packet and store it to the memory then flood to their neighbor nodes to ensure that they get the packet or not. Each node in the network generates the Gradient which includes the direction in which the data will be send and the values of data rate. When a node found data then it compared with the information that it store in the cache, if it matches the node is supposed to be the source node and it cyclically broadcast a message at low rate to ensure sense the data. When the sink receive many detection events, which means there are multiple paths that are going to source, it broadcast a reinforcement message to one path which have the least delay by enhance the data rate in the interest packet.

4. Quality of services in terms delay, throughput, network lifetime etc.

III. Related Works

The main idea of this paper is to study about the current state of fault tolerant routing techniques.

a) Alternate path routing or Retransmission based schemes

In this section, retransmission based routing protocols are described and culminate the key ideas.

Fault tolerance: if the reinforced path fails then the sink will not sense or detect any data. For rerouting the lost data it reinitiates the reinforcement message. Here to provide a fast recovery from the path failure the sink must be cyclically broadcast the reinforcement message to hurriedly found the additional path that created on the demand of this case.

Since this protocol is based upon the query driven data delivery concept, so it can works for such application that are based upon environment monitoring and requiring the continuous data delivery to the sink. This protocol is not be supposed as the energy efficient protocol. Sensor nodes may also introduce the overhead by the matching data and queries.

Informer homed routing protocol (IHR) [21] for *WSN.* This protocol is to prevent from the data loss, and to increase the data reliability. There are two cluster heads are choose based upon the energy called primary cluster head and the backup cluster head. The backup cluster head is used when the failure occur and have less energy than the primary cluster head. Sensor nodes send the data to the primary cluster head then primary cluster head send it to the sink. Backup cluster head receive the beacon message it means that the primary cluster head is alive. If beacon messages stops received to backup cluster head it means that primary cluster head is fail.

Fault tolerance: When a path failure occur, the beacon message stop received that are send by the primary cluster head to backup cluster head. Backup cluster head wait for particular time period after then it again retransmit the data packet which are interrupted due to the failure. Finally the traffic move to the backup cluster head. If the service path set up again, then the traffic back move on it.

Highly Resilient, Energy Efficient Multipath Routing Protocol (HREEMRP) [7] for is based upon he directed diffusion concept. There are some multipath routing schemes that finds several moderately disjoint paths, these are not the disjoint path, alternatively they are braided multipath for maintain the multipath to keep the low cost, and to rapidly recover from the path failure. The periodic flooding avoided by this protocol.

Fault tolerance: Multipath between source node and sink set up by network, one path is known as the primary

path from where the data route from source to sink and the additional path is maintained by the sending keep-alive data continuously. Thus if primary path failed then nodes can recover quickly by reinforcing the other path to retransmit the data packets. In this case energy is consumed because all the paths from source to sink are created in advance and additional path maintained by sending the keep-alive data continuously.

b) Concurrent path routing or Replication based schemes

Now a days the research provide us such protocols by which we can send the data packet over multipath to get reliability. In this section, retransmission based routing protocols are described and culminate the key ideas.

Table 3 : Summery of the Multipath Routing Protocol Baseed Upon Concurrent Path Rouing

Features / Protocol	Reliability mechanism used	Type of path	Path choose by	Performance parameter
ReInForm [20,10]	Copy the original packet	Link-disjoint	Source node	Reliability
N to 1 multipath routing [11]	Packet salvaging	Node-disjoint	Source node and intermediate node	Reliability
H-SPREAD [12]	Erasure coding	Node-disjoint	Source node and intermediate node	Reliability and security
MMSPEED [13]	Copy the original packet	Partially-disjoint	Source node and intermediate node	Reliability and delay
MCMP [14]	Copy the original packet	Partially-disjoint	Intermediate node	Data delivery ratio and delay
ECMP [15]	Copy the original packet	Partially-disjoint	Intermediate node	Data delivery ratio, Delay and network lifetime

Reliable Information Forwarding (ReInForm) using Multiple Paths in Sensor Networks [20, 10]. In the functioning of this protocol the sink cyclically broadcast a routing update packet in the network by this each node become to know its neighbor node and the hop count to the sink. When the source node wants to send the data, it generates a packet with dynamic packet state (DSP) fields in the header that have the network condition (local channel error, hop distance to the sink, desired reliability).Multiple copies of the data packet are created to be sent on multipath to the sink (the number of these multipath is therefore a function of the reliability) depending on the desired reliability identified by the source node. To forward the packet each intermediate node uses the information in the *DSP* and decides how much number of copies of the data packet is sent over the multipath. Mostly, the intermediate nodes take decision of which neighbors to forward the packet to (usually the node which is closer to the sink are chosen, otherwise random nodes are chosen). This process continues until the data packet reaches the sink.

Fault Tolerance: Fault tolerance provided in the *Rein Form* by sending multiple copies of the same packet to the sink over randomly chosen paths. This duplication occurs at the source node or at every intermediate node in the network. Thus in this scheme a higher delivery ratio or overhead is reached. But the advantage is that if some data packet is lost by any reason then original packet can still be recovered from the other duplicated packets.

N to 1 multipath routing protocol [11] is proposed to converge cast the traffic at different path. The main purpose of these protocols finds multiple node disjoint path from all sensor nodes to sink simultaneously. Here it improves the data transmission reliability. N to 1 multipath routing protocol performed by a single flooding strategy in two phases called *branch aware flooding* and *multipath extension flooding.*

In *branch aware flooding* the all source nodes find the several paths to the single sink and update a *route table*. In addition, if an intermediate node overhears a route update message then this path will also add to routing table. In *multipath extension flooding* more paths are discover from source to sink.

Fault tolerance: here the traffic can be introduced by data transmission from single path. To avoid this N to 1 discover an additional approach. By this each link between two individual nodes that belongs to different branches of spanning tree also establish an additional path. Hence the traffic split in to several segments.

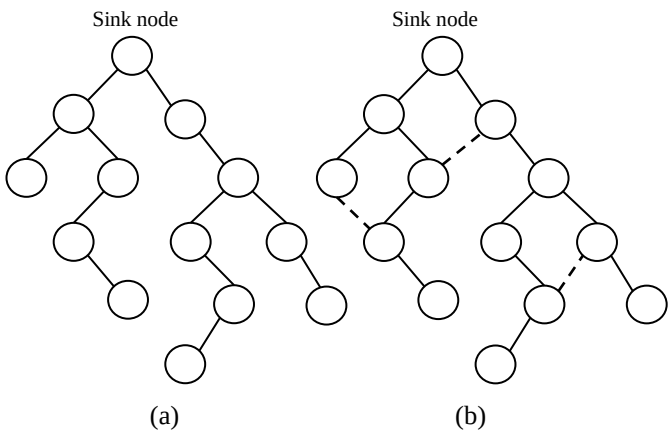

Figure 1: (a) Spanning tree constructed by initial flooding in N-to-1 MRP. (b) Multipath discovery using multipath extension flooding technique

H-SPREAD multipath routing protocol [12] is a combination of N to 1 multipath routing protocol and hybrid data transmission technique. H-SPREAD improves the reliability and secures the data transmission in WSN. It uses the threshold secret sharing scheme, and path discovery. H-SPREAD only improves the reliability and secure data delivery but it cannot secure individual nodes.

Fault tolerance: In this algorithm each data packet are divided in segments $M_1, 2, M_3, \ldots\ldots\ldots\ldots M_n$ by source node by using secret sharing strategy and then transmit over the different path towards the sink, when the number of paths get failed due to node failure, the original message can still be reached at destination node because it use special characteristics threshold secret scheme.

Multipath multispeed protocol (MMSPEED) [13] is based upon cross layer design between Mac layer and network to provide timeliness and reliability. From timeliness perspective, MMSPEED extend the SPEED protocol [17] by introduce the various speed levels the takes guarantees of data packet delivery. Let realized the utilize speed notion by following figure 2.Assume node A forward data packet to its neighbor node B, which reduce the geographic distance to the destination about meters. Here estimated delay over A-B (i.e.$delay_{A\_B}$) and achievable progress speed calculated as: $Speed_{A\_B}=(distance_{A\_C}-distance_{B\_C})/delay_{A\_B}$

Here the reliability demand also be achieved. The delay requirements are satisfied through various applications. MMSPEED provides the different speed layer over a single network. The data packets are assigned to different speed layer and placed in the suitable queue by the speed category. The FCFS policy is applied here. This technique also ensures that data serviced according to their priority i.e. high priority packet are serviced before low priority packets. Because it is cross layer design between Mac layer and network so contention based Mac protocol utilize the CSMA/CA mechanism [18, 19] to perform channel access, that employee the local priority data transmission at network layer not at the link layer.

Fault tolerance: As mentioned above MMSPEED provide different QoS guarantee in two domains by combine the geographic forwarding technique with a multipath routing approach. The results show that it provide us the successful data transmission over low power wireless link that highly depend upon the interference power of receiver distance but it cannot support long life application because it required extra energy for data transmission.

Geographic progress when we send data packet through node B

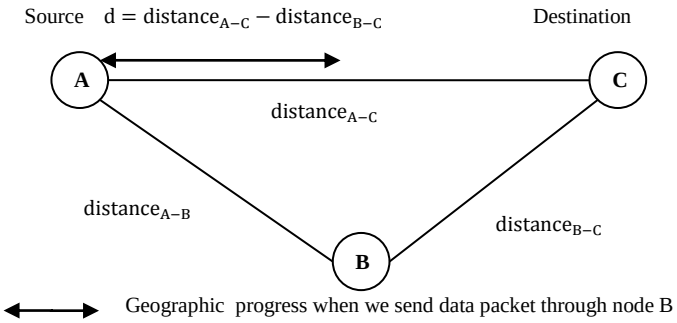

Figure 2 : Progress speed from node A to node B towards the destination node

Multi constrained QoS multipath routing(MCMP) [14] is mainly designed to provide QoS in terms of reliability and delay. MCMP develop according to linear programming approach which defined end to end soft QoS problem by deterministic approximation. Using following equation MCMP maps the delay and reliability along different path to the sink node.

$$L_i^d = D - \frac{D_i}{h_i} \quad (1)$$

$$L_i^r = \sqrt[h_i]{R_i} \quad (2)$$

Here L_i^d and Lir represent delay and reliability requirements at node i.

D_i is delay by packet at node i.

R_i is fraction of reliability requirements assigned to path passing by node i.

h_i is hop count from node I to sink.

MCMP utilize the two strategies i.e. delay and reliability. The delay requirement of the intended application fulfilled when all intermediate node used equation 1. To choose the neighbor node during route discovery. To achieve reliability each node selects one or set of neighbor nodes which provide reliability toward the sink. Therefore, at route discovery each source node discovered the set of partially disjoint path that satisfy the delay and reliability demands.

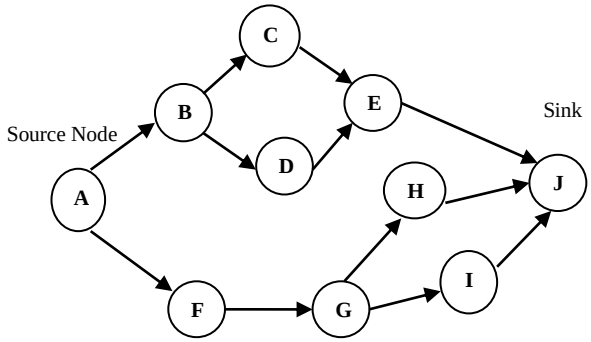

Figure 3 : Partially disjoint paths established by MCMP

Fault tolerance: In figure 3 demonstrate discovered path by MCMP. According to the structure the source node and intermediate node discover multiple paths towards the sink. In figure node G forward two copies to intermediate node I and node H. in that case if node H failed by any reason then the same data carried by node I reach at the sink. But the main disadvantage of MCMP is data redundancy. It is not used partially disjoint path that are usually located nearby, means that high data rate transmission cause interference.

Energy constrained multipath routing protocol (ECMP) [15] is the enhanced version of MCMP. It provides energy efficient communication. As MCMP it also satisfies the QOS in terms of delay and reliability requirements of intended application. It described earlier that in MCMP protocol intermediate node select their neighbor nodes to satisfy the delay and reliability requirement. In variance, ECMP protocol describes the energy optimization problem. This problem is satisfied by delay reliability and another geo-spatial energy consumption to provide QoS routing in network. The main purpose to design ECMP is to support multi-constrained QoS routing with minimum energy consumption. To elaborate this let consider the figure 4.

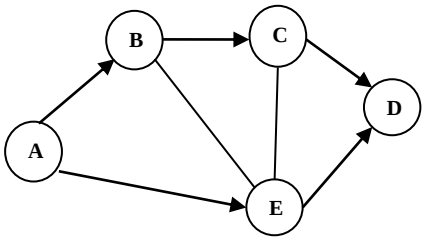

Figure 4 : Link selection according to the geo-spatial energy consumption constraint

Fault tolerance: It clearly seen that node A have two neighbor node B and node E and distance between node A and node B is shorter then node A to node E [16]. So energy consumed by data transmission from link A to B is lower than link A to E. so node B is selected as the intermediate nose to send the data. In MCMP, node randomly chooses their next-hop neighbor node without checking its energy consumption. But in the ECMP it refines the set of next hop nodes, and chooses that node which considers the energy efficiency of the link toward the neighbor node.

IV. Conclusion

There are various routing protocols that have been proposed in the literature to support fault tolerance in WSNs. This paper focuses on the various multipath routing protocols, in which the technique of the protocol is described along with their fault tolerant mechanisms. Table I and II are the summery tables which are drawn on the basis of some important parameters like reliability mechanism, route maintenance, path chooser and performance parameter.

References Références Referencias

1. J. N. Al Karaki and A. E. Kamal, "Routing techniques in wireless sensornetworks: A survey", IEEE Wireless Communications, vol. 11, Issue 6, Egypt, 2004, PP. 6-28
2. K. Akkaya and M. Younis, "A survey on routing protocols for wireless Sensor network", in the Elsevier Ad Hoc Network Journal, Vol. 3/3, 2005, PP. 325-349
3. Couto, D.S.J.D.; Aguayo, D.; Bicket, J.; Morris, R. A High-Throughput Path Metric forMulti-Hop Wireless Routing. *Wirel. Netw.* 2005, *11*, PP. 419–434.
4. C. Intanagonwiwat, R. Govindan, and D. Estrin, "DirectedDiffusion: A Scalable and Robust Communication Paradigm forSensor Networks," ACM Intl. Conf. on Mobile Computing andNetworking, 2000, PP. 56-67.
5. Son, D.; Krishnamachari, B.; Heidemann, J. Experimental Study of Concurrent Transmission in Wireless Sensor Networks. In *Proceedings of the 4th International Conference on Embedded Networked Sensor Systems (SenSys '06)*, Boulder, CO, USA, 31 October–3 November 2006; PP. 237–250.
6. N. Hoang and V. Son, "disjoint and braided MultipathRouting for Wireless Sensor Networks" International symposiumon Electrical & Electronics Engineering, , HCM city, Vietnam,Oct. 11-12, 2005.
7. D. Ganesan, R. Govindan, S. Shenker, and D. Estrin, "Highlyresilient,energy-efficient multipath routing in wireless sensornetworks", in Proc. of ACM MobiHoc'01, Long Beach, CA,USA, Oct. 2001.
8. S. Kim, R. Fonseca, and D. Culler, "Reliable Transfer onWireless Sensor Networks", The First IEEE InternationalConference on Sensor and Ad hoc Communications andNetworks, Oct. 2004, PP. 449-459.
9. Woo, A.; Tong, T.; Culler, D. Taming the Underlying Challenges of Reliable Multihop Routing in Sensor Networks. In *Proceedings of the 1st International Conference on Embedded Networked Sensor Systems*, Los Angeles, CA, USA, 5–7 November 2003; PP. 14–27.
10. Deb, B.; Bhatnagar, S.; Nath, B. ReInForM: Reliable Information Forwarding Using MultiplePaths in Sensor Networks. In *Proceedings of the 28th Annual IEEE International Conference onLocal Computer Networks (LCN'03)*, Bonn, Germany, 20–24 October 2003; PP. 406–415.
11. Lou, W. An Efficient N-to-1 Multipath Routing Protocol in Wireless Sensor Networks. In*Proceedings of the 2nd IEEE International Conference on Mobile Ad-hoc and Sensor System(MASS '05)*, Washington, DC, USA, 7–10 November 2005; PP. 672–680.
12. Lou, W.; Kwon, Y. H-SPREAD: A Hybrid Multipath Scheme for Secure and Reliable DataCollection in

Wireless Sensor Networks. *IEEE Trans. Veh Tech.* 2006, *55*, PP. 1320–1330.
13. Felemban, E.; Lee, C.G.; Ekici, E. MMSPEED: Multipath Multi-SPEED Protocol for QoSGuarantee of Reliability and Timeliness in Wireless Sensor Networks. *IEEE Trans. MobileComput.* 2006, *5*, PP. 738–754.
14. Huang, X.; Fang, Y. Multiconstrained QoS Multipath Routing in Wireless Sensor Networks. *J.Wirel. Netw.* 2007, *14*, PP. 465–478.
15. Bagula, A.; Mazandu, K. Energy Constrained Multipath Routing in Wireless Sensor Networks. In*Proceeding of the 5th International Conference on Ubiquitous Intelligence and Computing*, Oslo,Norway, 23–25 June 2008; PP. 453–467.
16. Li, W.; Cassandras, C.G. A Minimum-Power Wireless Sensor Network Self-Deployment Scheme.In *Proceedings of IEEE Wireless Communications and Networking Conference*, New Orleans, LA,USA, 13–17 March 2005; PP. 1897–1902.
17. Tian, H.; Stankovic, J.A.; Chenyang, L.; Abdelzaher, T. SPEED: A Stateless Protocol forReal-Time Communication in Sensor Networks. In *Proceedings of the 23rd InternationalConference on Distributed Computing Systems*, Providence, RI, USA, 19–22 May 2003; PP. 46–55.
18. Dezfouli, B.; Radi, M.; Abd Razak, S. A Cross-Layer Approach for Minimizing Interference andLatency of Medium Access in Wireless Sensor Networks. *Int. J. Comput. Netw. Commun.* 2010, *2*, PP. 126–142.
19. Dezfouli, B.; Radi, M.; Nematbakhsh, M.A.; Razak, S.A. A Medium Access Control Protocolwith Adaptive Parent Selection Mechanism for Large-Scale Sensor Networks. In *Proceedings ofthe 2011 IEEE Workshops of International Conference on Advanced Information Networking andApplications (WAINA '11)*, Singapore, 22–25 March 2011; PP. 402–408.
20. B. Deb, S. Bhatnagar, and B. Nath, "ReInForm: ReliableInformation Forwarding Using Multiple Paths in SensorNetworks", Proceed of the 28th IEEE Int'1 Conf. on LocalComputer Networks, Bonn, Germany, Oct. 2003, PP. 406-415.
21. Meikang Qiu, Zhong Ming, Jiayin Li, Jianning Liu, Gang Quan, Yongxin Zhu,"Informer homed routing fault tolerance mechanism for wireless sensor networks", in the ElsevierJournal of Systems Architecture 59 (2013) PP. 260–270

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Global Journal of Computer Science and Technology: G Interdisciplinary
Volume 15 Issue 3 Version 1.0 Year 2015
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Steganography Images Detection using Different Steganalysis Techniques with Markov Chain Features

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Abstract- Steganography is the art of covered or hidden writing. It is used for criminal activities applications environment. In this paper we focus on implementation of effective detection technique is an essential task in digital images. Previously many number of detection techniques are available for steganography images. After implementation of all approaches also again some challenges are available. This paper presents comparative study in between different steganalysis techniques. Different techniques are providing different results. Analyze of all techniques detection and embedding performance results. Finally we can decide one best steganalysis technique. It saves time and increases accuracy compare to all previous methods.

Index Terms: *steganography, steganalysis technique, digital images, markov chain features.*

GJCST-G Classification: *H.2.8, I.3.3*

Strictly as per the compliance and regulations of:

Steganography Images Detection using Different Steganalysis Techniques with Markov Chain Features

Rajendraprasad K[α] & Dr. V. B. Narasimha[σ]

Abstract- Steganography is the art of covered or hidden writing. It is used for criminal activities applications environment. In this paper we focus on implementation of effective detection technique is an essential task in digital images. Previously many number of detection techniques are available for steganography images. After implementation of all approaches also again some challenges are available. This paper presents comparative study in between different steganalysis techniques. Different techniques are providing different results. Analyze of all techniques detection and embedding performance results. Finally we can decide one best steganalysis technique. It saves time and increases accuracy compare to all previous methods.

Index Terms: steganography, steganalysis technique, digital images, markov chain features.

I. Introduction

Steganography is sometimes referred to as data hiding. Steganalysis technique is opposite to steganography. Steganalysis technique focuses on detecting the presence of hiding data. Steganalysis approaches are two types. Those are

1. Target approach
2. Blind steganalysis

Target approaches provide high accurate detection and reliable results compare to previous other steganalysis techniques. Previously many number of steganalysis techniques are design. Those techniques are steganography detectors, rich model detection scheme, statistics based approach, and movement based approaches. All existing approaches are not efficient under detection and reliable results generation.

In this paper design of new detection scheme using feature set. Feature set consist of different dimensions of input content. Combine of all dimensions of features display as a highly efficient detection results. Comparision study with other techniques also discuss in the remaining sections also. After completion of comparative study which technique is considerable that is also we can decide here.

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II. Related Work

Counter technique of image stenography is known as steganalysis. It's identifies the artifacts that existing in stenography images. Steganalysis provides analysis results from hidden information. Different steganalysis approaches information described below here.

Image stenography detectors contain two parts. Those two parts are image model and machine learning tool. Image model chosen training set of stego and cover images. Primary here we focus on detection accuracy from image model. Stenographic embedding operation image insensitive content converts into sensitive information. We can capture as many dependencies among individual image elements. Observation of all dependencies some of the disturbances are available here. Now here we can calculate the measurement features using spatial and frequency domain. These are DCT (Discrete Cosine Transform) coefficients. All domains of features we can extract with different iterations. Different iterations of features store into different matrices. Combine of all matrices display improved detection accuracy. This kind of process we can call as machine learning from all dimensions.

Here one richer model of JPEG images has different number of sub models. 1. Here capture the DCT coefficients using parallel channels. 2. Joint operation applies on parallel channels DCT coefficients. 3. Finally improved DCT statistical coefficients values are displayed here. Statistical coefficients are useful for construction of image models and steganalysis. Steganalysis results are improved and enhanced in the form robustness and scalability. Finally again we observed some more accuracy related issues.

Next other steganalysis approaches are introduced for increased statistical robustness values and scalability. New steganalysis approaches we can apply on low dimensional and high dimensional environment also. Collection of all dimensions features information and create feature set.

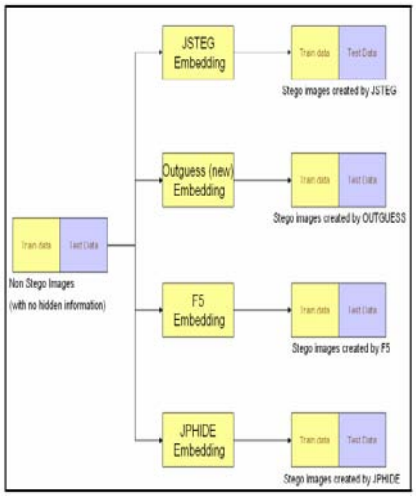

Fig. 1: Steganalysis Procedure

Using higher order statistics in digital images detects stenographic images information. Here we can use quardrature mirror filters for separable of decomposition values in stenographic images. Here two types of separable filters are available. Those are vertical and horizontal filters. Filtering operation can perform subsequently. After filtering operation then we can calculate the statistics using mean, variance and skewness parameters. Finally here we can calculate error statistics also. Statistical features based detection gives effective steganalysis accuracy results compare to previous methods.

After training operation on images using steganographic scheme next apply universal blind detection scheme. Here we can use optimal linear predictor for wavelet coefficients. All wavelet coefficients information collects and display statistical clustering results. Here we can apply threshold operation for separation of stego image from cover image. These kinds of operations are possible limited images database only. This method is not scale well and show low performance results.

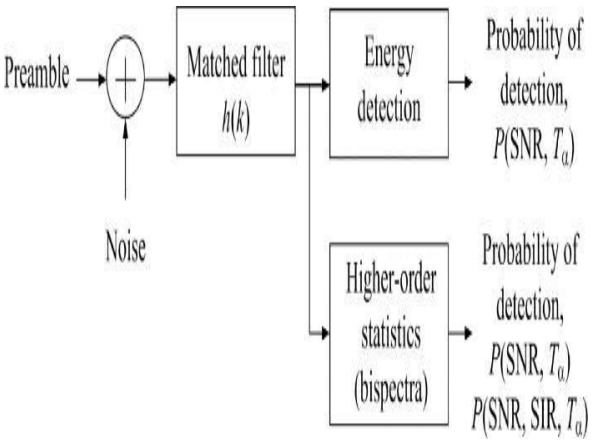

Fig. 2 : probability detection ratio

III. Problem Statement

Previous no single steganalysis technique is not work efficiently. Blindly all steganalysis techniques apply on stego images. All previous steganalysis techniques have take more time and resources.

The main goal of this paper was to the performance analysis of three different steganalysis techniques. Using three steganalysis results next we can perform detection accuracy comparison results. We test on various test images and performance calculation performs based on detected area. Comparison was made based on the number of negatives, positives and misclassified results.

IV. Implementation Details

Steganalysis techniques analyzed are listed below for detection of steganography images. Those techniques are

1. Discriminant analysis based Linear Discriminant Classification.
2. Support vector machines based classification.
3. Image scanning patterns

In all above steganalysis techniques are using logic and features are same. Only the major difference is classification technique only.

Detection technique Procedure

We shall present the new feature set for steganalysis on historical images. Feature set have scanning patterns, markov transition probability matrix, local and global calibrations and classification techniques.

a) Image Scanning Patterns

Image is divided into non overlapping blocks. Scan of each and every block of row and column and other Hibert directions also. We can observe all possible paths of correlations information also its better.

b) Intra and Inter Block Features

i. *Intra Block Features*

We can extract intra block features and store into matrix. Matrix contains DCT coefficients content information. All adjacent coefficients update into matrix. Next apply markov chain operations calculate transition probability features. Here we can perform different orders of markov probability matrix value.

ii. *Inter Block Features*

All orders of probability matrix features are rearrange then store into new matrix. Calculate the average of all orders transition probability value finally. Finally original image features set content display here.

c) Image Calibration

Image calibration is used for accurate statistics. Decompress and finally we can display original image.

d) Classification procedure

Extraction of features and calculate metrics of detection features information as a final output.

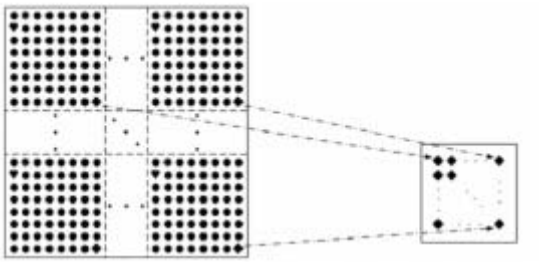

Fig. 3 : Block Feature Set Diagram

V. Experimental Results

Each approach has different features and working with different image databases, it's very complex. Following table have an aim to recapitulate the three approaches information.

Papers / Characteristics	Neural Network Based Steganalysis in Still Images	Steganalysis Based on Moments of Characteristic Functions Using Wavelet Decomposition, Prediction-Error Image, and NN	Texture based steganalysis
Type of steganalysis	Passive	Passive	Passive
Features	Transform domain includes : DFT, DCT, DWT	Moments of characteristics function, Prediction error-image.	LBP(Local Binary Pattern)
Type of Neural Network	Back-Propagation Neural Networks	Feed forward NN with back-propagation.	Not mentioned
Use of ANNs	For classifying	For classifying	For selecting
Number of data hiding methods	One " Brain Chen's quantization (3)	Five " Cox et al. SS, Piva et. al's blind SS , Huang and Shi's block SS, generic QIM and a generic LSB"	One " Blindside"
Images used	Each image is divided into 8x8 sub-block	1096 sample images included in the CorelDRAW (www.corel.com)	1000 clean color JPG images and 1000 stego-images
Results	Hidden images: 85.4% No hidden images: 75.0%	Five methods combined: 98.7 %	Hidden images: 68.5% No hidden images: 99.1%

Table 1: Comparative Study

VI. Conclusion and Future Work

We have proposed scanning patterns based approach for detection of JPEG steganography. Here we utilized feature set approaches for improving detection accuracy. Finally proposed approach compare with existing approaches. Proposed approach gives enhanced performance results, that's why proposed markov chain features approach is best

References References Referencias

1. Jessica Fridrich1, Miroslav Goljan1, Dorin Hogea2, Steganalysis of JPEG Images: Breaking the F5 Algorithm.
2. Z. Li, J. Chen, X.-n. Jiang, X.-t. Zeng and X.-z. Pan, "Blind JPEG steganalysis based on multi-domain feature", Journal of Zhejiang University (Engineering Science), vol. 45, no. 9, (2011), pp. 1528-1538 (in Chinese).
3. Q. Yun, S. C. Chen and W. Chen, "A Markov Process Based Approach to Effective Attacking JPEG Steganography", Proceedings of the IEEE international Conference on Multimedia & Expo 2005. Amstenlam, Netberlands:[s.n.], (2005), pp. 269-272.
4. C. Chen and Y. Q. Shi, "JPEG Image Steganalysis Utilizing both Intrablock and Interblock Correlations", IEEE international Symposium on Circuits and Systems. Seattle, Washington, USA: IEEE, (2008), pp. 3029-3032.
5. T. Pevny and J. Fridrich, "Merging Markov and DCT features for multi-class JPEG steganalysis", Proceedings of the 8th information Hiding Workshop. Alexandria, VA, USA: Springer-Verlag, (2007), pp. 249-264.
6. J. Kodovsky and J. Fridrich, "Calibration Revisited", Proceeding of the 11th ACM Multimedia Security Workshop, (2009), pp. 63-74.
7. F. Huang and J. Huang, "Calibration based universal JPEG steganalysis", Science in china series F: Information sciences, vol. 52, no. 2, (2009), pp. 260-268.
8. K. Li and X.-j. Ping, "Regional Correlation Based Blind Dection of JPEG Image Steganography", Journal of Information Engineering University, vol. 13, no. 3, (2012), pp. 306-311 (in Chinese).
9. T. Pevny, P. Bas and J. Fridrich, "Steganalysis by subtractive pixel adjacency matrix", IEEE Transaction on Information Forensics and Security, vol. 5, no. 2, (2010), pp. 215-224.
10. C. C. Chang and C. J. Lin, "LIBSVM: A library for Support Vector Machines", http://www.csie.ntu.edu.tw/~cjlin/libsvm.

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- Significant conclusions or questions that track from the research(es)

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	A-B	**C-D**	**E-F**
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Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
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ISSN 9754350