CHAPTER 5

CONCLUSIONS AND SCOPE FOR FUTURE RESEARCH

5.1 CONCLUSIONS

Wireless multimedia sensor network (WMSN) is used for sensitive applications like surveillance applications. In the case of surveillance applications, the captured video must be transmitted through the network to the monitoring site in a secured manner so that necessary action can be taken. The video data to be transmitted is enormous and, the constraints of WMSN compel reduction in data to be transmitted through the network. Hence compressed sensing (CS) technique is adopted for reducing the data to be transmitted with reduced complexity. CS framework is developed for video by proposing efficient measurement matrices for extracting the useful measurements from the video data. The measurement matrices are proposed by considering the storage and energy constraints of the sensor node. Also efficient object detection and security techniques are proposed for secured video transmission.

Memory and energy efficient sensing matrices are proposed for the CS framework for overcoming the storage, energy and time complexity of the existing gaussian sensing matrix. A Video Compressed Sensing framework based on the Discrete Wavelet Transform-Discrete Cosine Transform (DWT-DCT) hybrid approach is proposed which is compared with the DCT and DWT based CS approaches. The simulation results of the proposed measurement matrices shows that it yields better PSNR even for fewer
measurements when compared to the gaussian measurement matrix. Experimental evaluation is done by transmitting the measurements from the source node to the sink node using TelosB nodes under Contiki OS platform. The network is formed by using the TelosB nodes in line and random deployment scenarios. The results show that in line deployment, the packet loss is less yielding better PSNR when compared with the random deployment. The proposed hybrid matrix is best suitable for WMSN, as it yields better PSNR for small number of measurements and the memory, energy and time for generating the matrix is also less that prolongs the lifetime of the network. The results also show the storage, energy computation and computational time for the MES matrix and hybrid matrix being irrespective of the size of the measurement matrix when compared to the gaussian matrix. The DWT-DCT hybrid approach yields better PSNR for fewer measurements when compared with standalone DCT and DWT approaches. The experimental results show that the transmission energy is 50% less on an average and the end-to-end delay is 52 % less when compared to raw frame transmission.

Energy efficient CS based anomaly detection system for video surveillance application using WMSN is proposed. It can detect multiple objects and transmit the required measurements to the receiver. In traditional surveillance system, transmission of the entire video leads to wastage of energy which can be overcome by transmitting only few measurements with which the foreground object can be reconstructed. A simple and novel mean measurement differencing with adaptive threshold strategy (MMD-ATS) approach is proposed for improving the detection accuracy with reduced energy and complexity. A measurement matrix based foreground detection vector (FDV) is also proposed for detecting the objects by designing an efficient threshold. From the results it is concluded that on an average the MMD-ATS framework, gaussian matrix based FDV and hybrid matrix based
FDV yields around 81%, 66% and 88% detection accuracy respectively. It is also observed that the proposed framework works well for both single and multi object scenarios. The proposed MMD-ATS framework and the measurement matrix based FDV framework achieve around 87% and 95% reduction in transmission energy respectively. The MMD-ATS framework achieves 24% reduction in transmission energy compared to FMD framework while measurement matrix based FDV achieves around 18% reduction compared to CS-BS framework. When a one minute video is transmitted every 10 minutes, the source node can serve up to 7.62 hours and relay node can withstand up to 428 days using hybrid matrix based FDV.

Once the measurements are obtained, it is necessary to transmit the measurements in a secured manner to the monitoring site. The person at the monitoring site can take action on the basis of the information. Whenever an intruder enters a restricted area it must be notified to the concerned authorities at the monitoring site. There is a chance of the intruder entering the area jamming the communication so that his presence is not notified. Hence it becomes necessary to provide efficient security mechanism for the network to transmit the information. A novel and simple pattern hopping security (PHS) mechanism is proposed for providing higher security level with less storage complexity thus making it best suitable for resource constrained sensor nodes. This mechanism adaptively switches to different channels at different instants of time thereby hiding the channel of operation from the attacker. An attacker monitoring the network will not be able to predict the channel in which the information will be transmitted at an instant of time thereby preventing him from jamming a channel.

Since the WMSN based video surveillance system can be used in private places like home and also for patient monitoring in hospitals, it is necessary to ensure the privacy of the person in the video. Hence the efficient
selective block security (SBS) approach is proposed for hiding the identity of the person in the video in case the attacker eavesdrops the communication. Security key values are generated based on the measurement matrix elements and is used for securing the compressed measurements. The attacker will not be able to reconstruct the video without the security keys even if he knows the sparsity level, measurement matrix and recovery algorithm. The SBS approach and the PHS approach have less storage complexity compared to the existing techniques. Increase in the number of blocks jammed by the attacker is observed when the measurements per packet increase.

The proposed CS based frameworks are tested in WMSN test bed consisting of WingZ as the source node and TelosB nodes as the relay nodes. The source algorithm is implemented in the WingZ and the measurements obtained in the WingZ are transmitted to the PC at the destination through TelosB nodes in a multihop manner. The frames were reconstructed from the received measurements using MATLAB.

5.2 SCOPE FOR FUTURE RESEARCH

The CS framework can be tested for many real time applications like patient health monitoring, home automation and border surveillance. Efficient and less complex CS based object detection algorithm for complex environments can be developed for WMSN. Many other security aspects can be investigated and solutions can be provided for building an efficient video surveillance system for WMSN.