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## P-14: Security Analysis and Implementation of Web-based Telemedicine Services with a Four-tier Architecture

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### Introduction

Security of Telemedicine applications is not often given adequate importance by the developers and healthcare administrators primarily to reduce cost. Though some security safeguards are employed by these applications to comply with existing medical data security and privacy regulations, these are not adequate in today's context. Moreover, in a web-based application environment not only the data but also the application itself is vulnerable to attackers. Keeping these concerns in mind, we present the design of a web-based, four-tier Telemedicine System which is accessible over desktops as well as handheld devices. We have illustrated how the proposed system differs from existing three-tier web applications.

### Material and Methods

In this paper we present the architecture of a web-based four-tier telemedicine system which has been developed with a major emphasis on security. Our work extends the existing three-tier application architecture to incorporate an additional layer of security. In this architecture we are able to protect not only the medical information but also the application components from hackers. We have illustrated how the proposed four-tier architecture imparts security, flexibility and robustness into the application. We also present an analysis of the security of the proposed system in the context of some common web-application vulnerabilities. Emphasis on application security has been given due to the recent rise in hacking incidents at the web application level. Thus, our approach looks into the four-tier architecture from an attacker's viewpoint and presents a simple road map for developing secure e-health application.

### Results

It is to be emphasized that the proposed four-tier architecture presents several advantages over existing three-teir applications. Firstly, let us consider the case of a typical threetier web application where the application logic / presentation logic is hosted on a public computer . This computer communicates with an Internal Database which is protected by a firewall. Since the web server is always hosted in the DMZ it is vulnerable to hacking attempts. If this server is compromised, the database is no longer hidden to the attacker. The attacker can easily modify the application components to perform arbitrary operations on the database. Moreover if the web application consists of codes written in the scripting languages the entire application logic is exposed to the hacker.  In comparison, the proposed four-tier system hosts the application components securely behind a firewall. The Web Proxy Layer consists of only executable codes. Hence the application logic is never visible to the attacker.

### Discussion

The proposed system, differs from existing web-based telemedicine services due to its architecture and its emphasis on application level vulnerabilities. We have illustrated how the introduction of the fourth layer or the Web Proxy Layer reduces the risk for many types of attacks. The advantages of the proposed four-tier architecture over existing three-tier architecture have also been highlighted. The security measures incorporated at various layers of the application shows how such a four-tier application can be protected against common web application vulnerabilities. Furthermore, how users can access healthcare data in the proposed system from any location using desktop computers as well as handheld devices has been discussed.

### References

[1] A.R. Al-Ali, A.O. Abdul Salam, L. Al-Zohlof, M. Manna and R. Zakaria, "A cyber medical center," Computer Methods and Programs in Biomedicine,  80(1),  pp. S85–S94,  December 2005.

[2] M. Masseroli, A. Visconti, S. G. Bano and F. Pinciroli, "He@lthCo-op: a web-based system to support distributed healthcare co-operative work," Computers in Biology and Medicine,  36(2),  pp. 109–127, February 2006.

[3] E. D. Lemaire, D. Deforge, S. Marshall and D. Curran, "A secure webbased approach for accessing transitional health information for people with traumatic brain injury," Computer Methods and Programs in Biomedicine, 81(3), pp. 213–219, 2006.

[4] J. Zhang, J. Sun, Y. Yang, X. Chen, L. Meng and P. Lian, "Web-based electronic patient records for collaborative medical applications,"  Computerized Medical Imaging and Graphics, 29(2), pp. 115–124, March–April 2005.