Final Year Project Report

Smart environment development kit

Project Advisor:

Dr. Adnan Shahzada

Submitted By:

Mahrukh Shahid **13022020102**

Muhammad Umair Haider **13022020150**

Saram Ashfaq13022020140

Session

2016-2017

University of Management and Technology

C-II Johar Town Lahore Pakistan

Dedication

To the courage & never losing hope

Final Approval

Panel of Examiners

1) **Head of Department** _____
   Department of Computer Science
   UMT Lahore

2) **Program Director (Final Year Projects)** _____
   Department of Computer Science
   UMT Lahore

3) **Supervisor** _____
   Department of Computer Science
   UMT Lahore

4) **Co-Supervisor** _____

ACKNOWLEDGEMENTS

Firstly, we are thankful to Allah in giving us this much achievement in this project and gave us the strength in completing our goals.

We give our appreciation to our Project Advisor Dr.Adnan Shahzada in guiding us in our field of work, he has helped up in many ways in regarding our project by giving us hope and correcting us when we go astray from our project objectives, he has helped us not just in our project but has given us a better understanding of this field of work and a better understanding in our team.

We would like to thank our families in supporting us in our work emotionally and all the sacrifices they made in achieving our goal

We would like to thank our friends and colleagues from this university and others who gave us their time to help us and make this Final Year Project a more memorable and worthy experience.

ABSTRACT

The paradigm shift from traditional computing towards the ubiquitous computing is introducing the idea of smart space. The ease in availability of numerous miniature devices and the wide-scale development of micro controllers have boosted the development of smart spaces. Although the hardware devices are mature but the designing, development and deployment frameworks are still lacking behind in forming a complete sophisticated deployable smart system.

The thesis focuses on figuring out and forming an appropriate approach to resolve the issues reside in the development & deployment of smart environment. The requirement of smart environment development framework is to cover all the phases from design to the deployment of the diversified smart spaces.

Our System will offer a layered architecture covering the seamless and transparent connectivity of physical objects with the simulated environment, development of customized simulation and visualization of the simulated environment will also be ensured. Simulated environment will contribute in analyzing the behavior of developed smart system in different situations before it is actually deployed in the physical world.

CONTENTS

1 INTRODUCTION 8

1.1 PROBLEM OVERVIEW ..... **ERROR! BOOKMARK NOT DEFINED.**
1.1.1 Connectivity ..... ***Error! Bookmark not defined.***
1.1.2 Data format ..... ***Error! Bookmark not defined.***
1.1.3 Smart collaboration ..... ***Error! Bookmark not defined.***
1.1.4 Context Awareness ..... ***Error! Bookmark not defined.***
1.1.5 Development & Deployment Phases ..... ***Error! Bookmark not defined.***
1.2 RESEARCH QUESTIONS ..... **ERROR! BOOKMARK NOT DEFINED.**
1.3 RESEARCH OBJECTIVES ..... **ERROR! BOOKMARK NOT DEFINED.**
1.4 METHODOLOGY ..... **ERROR! BOOKMARK NOT DEFINED.**
1.5 SIGNIFICANCE/ POTENTIAL APPLICATIONS ..... **ERROR! BOOKMARK NOT DEFINED.**

2 BACKGROUND ..... ERROR! BOOKMARK NOT DEFINED.

2.1 WHAT IS SMART ENVIRONMENT? ..... **ERROR! BOOKMARK NOT DEFINED.**
2.2 EXAMPLES OF SMART ENVIRONMENT ..... **ERROR! BOOKMARK NOT DEFINED.**
2.2.1 Smart Hospital Rooms: ..... ***Error! Bookmark not defined.***
2.2.2 Smart Farming ..... ***Error! Bookmark not defined.***
2.2.3 Smart Shopping: ..... ***Error! Bookmark not defined.***
2.3 SMART ENVIRONMENT INFRASTRUCTURE ..... **ERROR! BOOKMARK NOT DEFINED.**

3 LITERATURE REVIEW ..... ERROR! BOOKMARK NOT DEFINED.

3.1 RELATED SOFTWARE ..... **ERROR! BOOKMARK NOT DEFINED.**
3.1.1 UBIOSA [6] ..... ***Error! Bookmark not defined.***
3.1.2 OPENHAB [7] ..... ***Error! Bookmark not defined.***
3.1.3 FREEDOMOTIC [8] ..... ***Error! Bookmark not defined.***
3.1.4 SIAFU ..... ***Error! Bookmark not defined.***
3.2 GAP ANALYSIS ..... **ERROR! BOOKMARK NOT DEFINED.**
3.2.1 Strengths ..... ***Error! Bookmark not defined.***
3.2.2 Weaknesses ..... ***Error! Bookmark not defined.***
3.2.3 Issues ..... ***Error! Bookmark not defined.***
3.2.4 Comparison Chart ..... ***Error! Bookmark not defined.***

4 PROPOSED METHODOLOGY ..... ERROR! BOOKMARK NOT DEFINED.

4.1 SUGGESTED APPROACH ..... **ERROR! BOOKMARK NOT DEFINED.**
4.2 ALGORITHMS/ARCHITECTURE ..... **ERROR! BOOKMARK NOT DEFINED.**

5 DESIGN AND IMPLEMENTATION ..... ERROR! BOOKMARK NOT DEFINED.

5.1 SYSTEM ARCHITECTURE ..... **ERROR! BOOKMARK NOT DEFINED.**
5.1.1 Architecture Design ..... ***Error! Bookmark not defined.***
5.1.2 Heterogeneity & Self-Configurability ..... ***Error! Bookmark not defined.***
5.1.3 Context-Awareness & Dynamic Simulation ..... ***Error! Bookmark not defined.***
5.1.4 Mapping of Virtual and Physical Spaces ..... ***Error! Bookmark not defined.***
5.1.5 Design Feasibility ..... ***Error! Bookmark not defined.***
5.2 UML CLASS DIAGRAM ..... **ERROR! BOOKMARK NOT DEFINED.**
5.3 SYSTEM IMPLEMENTATION ..... **ERROR! BOOKMARK NOT DEFINED.**
5.3.1 Virtual Space State Modification ..... ***Error! Bookmark not defined.***
5.3.2 System Concurrency ..... ***Error! Bookmark not defined.***

6 EVALUATION ..... ERROR! BOOKMARK NOT DEFINED.

6.1 EXPERIMENTATION ..... **ERROR! BOOKMARK NOT DEFINED.**
6.1.1 Experimental Setup ..... ***Error! Bookmark not defined.***
6.1.2 Experiment Design/Details ..... ***Error! Bookmark not defined.***
6.2 RESULTS ..... **ERROR! BOOKMARK NOT DEFINED.**
6.3 DISCUSSION/ANALYSIS ..... **ERROR! BOOKMARK NOT DEFINED.**

7 CONCLUSION AND FUTURE WORK ..... ERROR! BOOKMARK NOT DEFINED.

8 REFERENCES/ BIBLIOGRAPHY ..... ERROR! BOOKMARK NOT DEFINED.

***9* APPENDIX** ..... ERROR! BOOKMARK NOT DEFINED.

9.1 GLOSSARY OF TERMS ..... **ERROR! BOOKMARK NOT DEFINED.**

DEFINITIONS AND ACRONYMS

Acronyms	Definition
UbiCom	Ubiquitous Computing
SE	Smart Environment
SEDK	Smart Environment Development Kit

LIST OF FIGURES

Figure 1.1: Smart Environment Development & Deployment Cycle**Error! Bookmark not defined.**

Figure 2.1: Smart Hospital Room.....**Error! Bookmark not defined.**
Figure 2.2: Smart Farming .....**Error! Bookmark not defined.**
Figure 2.3: Smart Shopping.....**Error! Bookmark not defined.**
Figure 2.4: Smart Environment Infrastructure .....**Error! Bookmark not defined.**
Figure 2.5: Hierarchy of Issues in Smart environment.....**Error! Bookmark not defined.**

Figure 3.1 UBIOSA Architecture Design.....**Error! Bookmark not defined.**
Figure 3.2 Hardware Component Connectivity.....**Error! Bookmark not defined.**
Figure 3.3 Functional layer.....**Error! Bookmark not defined.**
Figure 3.4 Freedomotic Architecture Design .....**Error! Bookmark not defined.**

Figure 4.1 Abstract System Design .....**Error! Bookmark not defined.**
Figure 4.2: Suggested Workflow of a Smart System .....**Error! Bookmark not defined.**
Figure 4.3: Suggested Design of System.....**Error! Bookmark not defined.**

Figure 5.1: Architecture Design of SEDK.....**Error! Bookmark not defined.**
Figure 5.2: Communication Methodology .....**Error! Bookmark not defined.**
Figure 5.3: Structure of Device Driver.....**Error! Bookmark not defined.**
Figure 5.4: Simulation Cycle.....**Error! Bookmark not defined.**
Figure 5.5: Features of Simulation Logic.....**Error! Bookmark not defined.**
Figure 5.6: Example of Context-Aware Simulation.....**Error! Bookmark not defined.**
Figure 5.7: Example of Virtual & Physical Space Mapping .....**Error! Bookmark not defined.**
Figure 5.8: Message Flow between Layers .....**Error! Bookmark not defined.**
Figure 5.9: Simulation & Visualization Class Diagram .....**Error! Bookmark not defined.**
Figure 5.10: Hardware Interface Class Diagram .....**Error! Bookmark not defined.**
Figure 5.11: Implementation Model.....**Error! Bookmark not defined.**
Figure 5.12: Virtual Space State Update process .....**Error! Bookmark not defined.**
Figure 5.13: Example of Virtual Space State Modification Procedure**Error! Bookmark not defined.**
Figure 5.14: Concurrency Model of System .....**Error! Bookmark not defined.**

Figure 6.1: Walls of apartment highlighted.....**Error! Bookmark not defined.**
Figure 6.2: Background map of Apartment.....**Error! Bookmark not defined.**
Figure 6.3: Objects Inserted in System Screen shot .....**Error! Bookmark not defined.**
Figure 6.4: System Running Screen shot.....**Error! Bookmark not defined.**
Figure 6.5: Flow of System .....**Error! Bookmark not defined.**
Figure 6.6: Demo Circuit.....**Error! Bookmark not defined.**
Figure 6.7: Demo Arduino Listening for Commands.....**Error! Bookmark not defined.**
Figure 6.8: Demo Relay controlling.....**Error! Bookmark not defined.**
Figure 6.9: Demo Screen Shot of System.....**Error! Bookmark not defined.**

LIST OF TABLES

Table 1: Relevant Existing Solution Comparison ..... **Error! Bookmark not defined.**
Table 2: System Efficiency ..... **Error! Bookmark not defined.**

1 INTRODUCTION

It is the beginning of the era of Calm Technology

"….the age of calm technology, when technology reside in the background of our lives."[1]

- Mark Weiser.

The result to tremendous amount of development and transformation in the world of technology in the last few decades, technical advancement have gained so much maturity that every device supports mobility, connectivity and smartness. With such properties these devices as an individual have established a significant space in our day to day life e.g. smart phones, tablets, smart wearable gadgets etc. Due to the low cost availability and mini sizes of device like wireless communication modules, parallel processing modules,multiple sensing devices, actuating devices and micro controllers opened up a path to an incredible development phase. The next major millstone is to elevate the identity of these devices from an individual smart device to the cluster of smart devices giving a shape to a smart eco system.