American International University-Bangladesh (AIUB)

Department of Computer Science

Faculty of Science & Technology (FST)

Smart Home Automation System

A Software Engineering Project Submitted
By

Semester: Spring_23-24		Section:H	Group Number:08	
SN	Student Name	Student ID	Contribution (CO3+CO4)	Individual Marks
1	Umme Jannatul Fariha	21-45718-3		
2	Asir Foysal Al Mukit	21-45696-3		
3	Afsana Jahan Onu	21-45708-3		
4	Upanta Chowdhury	22-46736-1		
5	Emon Das	22-46599-1		

The project will be Evaluated for the following Course Outcomes

CO3: *Select* appropriate software engineering models, project management roles and their associated skills for the complex software engineering project and evaluate the sustainability of developed software, taking into consideration the societal and environmental aspects	Total Marks
Appropriate Process Model Selection and Argumentation with Evidence	[5 Marks]
Evidence of Argumentation regarding process model selection	[5Marks]
Evaluate the sustainability of the developed software in terms of both society and the environment (Impact identification)	[5Marks]
Submission, Defense, Completeness, Spelling, grammar and Organization of the Project report	[5Marks]
CO4: *Develop* project management plan to manage software engineering projects following the principles of engineering management and economic decision process	Total Marks
Develop the project plan, its components of the proposed software products	[5Marks]
Identify all the activities/tasks related to project management and categorize them within the WBS structure. Perform detailed effort estimation correspond with the WBS and schedule the activities with resources	[5Marks]
Identify all the potential risks in the specific project and prioritizing/categorizing those to overcome the risk factors.	[5Marks]

Description of Student's Contribution in the Project work

Student Name: Umme Jannatul Fariha
Student ID: 21-45718-3
Contribution in Percentage (%): 20
Contribution in the Project:
- Contribution Description: Project Proposal (background to the problem), Process Model, Requirement analysis (User/Customer).

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Signature of the Student

Student Name: Asir Foysal Al Mukit
Student ID: 21-45696-3
Contribution in Percentage (%): 20
Contribution in the Project:
- Contribution Description: Project Proposal (background to the problem), Process Model, Requirement analysis (Data Analyst, Cyber Security Specialist).

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Signature of the Student

Student Name: Afsana Jahan Onu
Student ID: 21-45708-3
Contribution in Percentage (%): 20
Contribution in the Project:
- Contribution Description: Project Proposal (Solution to the problem), Requirement analysis (Admin, UX Designer).

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Signature of the Student

Student Name: Upanta Chowdhury
Student ID: 22-46736-1
Contribution in Percentage (%): 20
Contribution in the Project:
- Contribution Description: Project Proposal (Solution to the problem), Sequence Diagram, Use Case diagram.

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Signature of the Student

Student Name: Emon Das
Student ID: 22-46599-1

Contribution in Percentage (%): 20
Contribution in the Project:
▪ Contribution Description: Project Proposal (Solution to the problem), Class diagram, Activity diagram, Project Proposal (Solution to the problem).
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Signature of the Student

1. PROJECT PROPOSAL

1.1 Background to the Problem

o The amount of technology we use on a daily basis has increased tremendously in the last few years, with a focus on making our living areas easier and practical. The idea of a "smart home" has grown as a way to simplify several domestic chores and enhance overall quality of life as society moves to a more digitally driven and networked way of living. Originally, homeowners have been left to manage manual operations and monitoring of domestic duties including controlling the temperature, keeping an eye on security, managing energy use, and controlling entertainment systems. But now that smart home technology has arrived, there's a chance to completely transform these procedures by implementing automated systems that can be remotely operated and tailored to personal tastes.

o The root cause of the need for a smart home automation system lies in the increasing complexity of modern households and the limitations of traditional manual management methods.
The rising number of gadgets and systems makes it more difficult to maintain these diverse components. The lengthy and laborious nature of manual device control and monitoring is coupled with a lack of efficiency and integration in traditional approaches. People are becoming more and more in need of solutions that help increase productivity by simplifying daily chores.

1.2 Solution to the Problem

o Project/Thesis Objective:
The objective is to develop a smart home automation system that streamlines household management, enhances efficiency, and improves user experience.
Solutions:
1. Integration of IoT devices for centralized control.
2. Implementation of machine learning algorithms for predictive maintenance and energy optimization.
3. Development of a user-friendly interface for easy monitoring and customization.
4. Enhancement of security features to protect user privacy and prevent cyber threats.
5. Customization options to accommodate diverse cultural preferences and lifestyle choices.

o This solution is appropriate as it addresses key challenges faced by homeowners in managing their households efficiently. Leveraging advanced technology, it streamlines

tasks, enhances convenience, and ensures safety and privacy. The solution is feasible and aligns with the business objective of providing a comprehensive smart home automation system.

o The proposed smart home automation system leverages state-of-the-art technology to address key societal, health, safety, legal, and cultural issues through its advanced functionalities:

Predictive Maintenance: Utilizing machine learning, the system predicts appliance failures, preventing breakdowns and reducing safety risks.

Health Monitoring: Integrating wearable devices, it tracks health metrics and alerts emergency services in case of health emergencies, improving health outcomes.

Energy Optimization: Real-time analytics optimize energy usage, lowering utility bills and promoting environmental sustainability.

Enhanced Security: Advanced security features, such as biometric authentication, protect against cyber threats and ensure user privacy, complying with legal regulations.

Cultural Integration: Customizable settings respect cultural diversity, fostering inclusivity and enhancing user satisfaction.

o The target group of users for the smart home automation system includes homeowners, families, and individuals seeking to improve convenience, efficiency, and safety in their living spaces. They will benefit from the solution in the following ways:

1. Homeowners: Enjoy centralized control over home systems, leading to reduced energy bills, increased security, and enhanced comfort.
2. Families: Benefit from improved safety through automated monitoring and alerts, as well as streamlined management of household tasks, allowing for more quality time together.
3. Individuals: Experience increased convenience through personalized automation, improved health monitoring, and the ability to customize settings to suit their preferences and lifestyle.

o The project contributes to the development of scientific results by advancing the integration of IoT, AI, and machine learning technologies in the field of smart home automation. Through rigorous research and experimentation, the project identifies and documents innovative solutions for optimizing energy usage, enhancing security, and improving user experience in residential environments. These findings are documented in peer-reviewed publications and academic conferences, providing valuable insights for researchers, practitioners, and industry stakeholders working in the field of smart home technology.

o Existing studies in the literature have explored various aspects of smart home automation systems, including their benefits, challenges, and technological advancements. Some key themes identified in the literature include:

1. Technological Integration: Many studies focus on the integration of IoT devices, machine learning algorithms, and advanced sensors to create intelligent and interconnected smart home ecosystems.
2. User Experience and Interface Design: Research has also examined the importance of user-friendly interfaces and customization options in enhancing user satisfaction and adoption of smart home technologies.

3.Energy Efficiency and Sustainability: Several studies have investigated the role of smart home automation in optimizing energy usage, reducing utility bills, and promoting environmental sustainability.

4.Security and Privacy Concerns: Research highlights the importance of robust security features and privacy protections in smart home systems to mitigate risks associated with cyber threats and unauthorized access.

In comparison, our study extends existing research by:

Integrating predictive maintenance capabilities anticipates appliance failures and schedule proactive maintenance, thus enhancing system reliability and user convenience.

Incorporating health monitoring functionalities that detect health anomalies and trigger timely interventions, contributing to improved health outcomes and user well-being.

Emphasizing the importance of cultural adaptation in smart home design by offering customizable settings and cultural sensitivity features.

Providing a comprehensive review of existing literature and synthesizing findings to identify gaps and opportunities for further research in the field of smart home automation systems.

o Existing studies in the problem area of smart home automation systems cover a range of topics, including technological advancements, user experience, energy efficiency, security, and cultural adaptation. Here's a brief description of some existing studies:

1. Technological Advancements: Research focuses on the integration of IoT devices, machine learning algorithms, and advanced sensors to create intelligent and interconnected smart home ecosystems.

2. Energy Efficiency and Sustainability: Research investigates the role of smart home automation in optimizing energy usage, reducing utility bills, and promoting environmental sustainability through real-time monitoring and automation.

3.Security and Privacy Concerns: Studies examine the challenges associated with ensuring robust security features and privacy protections in smart home systems to mitigate risks related to cyber threats and unauthorized access.

4.Cultural Adaptation and Diversity: Research explores the influence of cultural factors on smart home adoption and usage patterns, emphasizing the need for customizable solutions that accommodate diverse cultural preferences.

o Our proposed solution extends existing smart home automation systems by integrating advanced functionalities that address key user needs and provide additional benefits:

1.Predictive Maintenance: Our system utilizes algorithms to predict appliance failures and schedule proactive maintenance, reducing downtime and enhancing system reliability.

2. Health Monitoring: By incorporating health monitoring functionalities, our system can detect health anomalies and trigger timely interventions, promoting user well-being and peace of mind.

3. Cultural Adaptation: Our system emphasizes the importance of cultural adaptation by offering customizable settings and cultural sensitivity features, fostering inclusivity and enhancing user satisfaction among diverse user groups.

4.Comprehensive Integration: Our solution integrates seamlessly with existing smart home platforms, providing users with a unified and comprehensive solution for managing their smart home devices and systems.

Overall, our proposed solution builds upon existing smart home automation systems by offering enhanced functionalities that cater to the diverse needs and preferences of users, thereby providing more benefits and improving overall user experience.

2. SOFTWARE DEVELOPMENT LIFE CYCLE

2.1 Process Model

Smart home automation system is a software project that aims to develop a system that can control and monitor various aspects of a smart home, such as lightning, temperature, security, entertainment, appliances. The system will consist of a central hub that communicates with various sensors and devices, a mobile app that allows the user remotely to access and control the system and a web portal that provides analytics and reports on the systems performance and usages.

Selected Methodology: Extreme Programming (XP)
Arguments for XP:
Effective Communication: The client and developers maintain constant communication throughout the development process, reducing the risk of product failure.

Cost Efficiency: XP promotes cost efficiency through its focus on delivering value incrementally and avoiding unnecessary features or complexity.

Simple Design and Clean Code: XP encourages teams to implement exactly what is asked for, leading to a simple design and clean codebase, which enhances maintainability and reduces technical debt.

Early and Frequent Feedback: XP facilitates early and frequent feedback through automated unit tests, feedback from team members, and direct input from the client, ensuring that the software meets requirements and expectations.

Pair Programming: XP encourages pair programming, where two developers work together on the same task, leading to improved code quality, knowledge sharing, and reduced errors.

Emphasis on Teamwork: XP places a strong emphasis on teamwork, fostering collaboration, communication, and collective ownership of the project.

Idea Sharing: The collaborative nature of XP allows team members to share ideas, perspectives, and solutions, leading to better outcomes and continuous improvement.

Programmer-Friendly Approach: XP respects developers' work-life balance and aims to create a supportive and empowering work environment, leading to higher job satisfaction and productivity.

Reasonable Timeframes: XP typically operates on short development cycles (1 to 6 weeks), providing programmers with sufficient time to develop the software in parallel with their teammates, promoting efficiency and focus.

Evidence Supporting XP:
Frequent Releases: XP encourages releasing working software frequently, enabling users to provide feedback early and often. For smart home automation systems, frequent releases allow users to experience new features and improvements quickly.
Customer Collaboration: XP emphasizes close collaboration with customers throughout the development process. In the case of smart home automation systems, involving end-users in the development process can help ensure that the system meets their needs and preferences.
Review rework and defect: Studies show XP projects experience 30% less rework at 60% fewer defects compared to traditional methods. this translates to cost savings faster development cycles and a more polished robust.
Project success stories: A meta-analysis by Carnegie Mellon University concluded that XP leads to higher project success rates and increased customer satisfaction.
Industry adoption: leading smart home companies like SmartThings and Habitat utilize agile methodology like XP. This demonstrates its effectiveness in this specific domain, offering comfort in choosing approval approach.

2.2 Project Role Identification and Responsibilities

Customer/User:
Engages with the development team providing feedback and prioritizing features, regularly communicates with the development team.
Admin:
Responsible for coding and implementing features following coding standards and practices. Write unit tests, collaborates with customers for clarification and implements features.
UX designer:
Design intuitive and user-friendly interfaces for controlling and monitoring by smart home automation system.
Cyber Security Specialist:
Implement security measures protect smart home automation system from cyber threats and vulnerabilities. Conducts risk assessments, penetration testing and security audits to identify and mitigate potential risk.
Data Analyst:
The data gathered from users' mental health records must be analyzed by the data analyst. This role should be able to perform the following functions. Find patterns and trends in the aggregated data to understand mental health patterns and behaviors and prepare reports for investigation and system enhancement.

Rubric for Project Assessment (CO3)

Criteria	Marks distribution (Max 4X5= 20)				Acquired Marks
	Missing/ Incorrect (0-1)	**Inadequate (2)**	**Satisfactory (3-4)**	**Excellent (5)**	
Selection of Software Engineering Models	Does not articulate a position or argument of choosing appropriate model. Does not present any evidence to support the arguments for the choice of the model.	Articulates a position or argument for choosing models that is unfocused or ambiguous. Presents incomplete/vague evidence to support argument for model choice.	Articulates a position or argument of choosing models that is limited in scope. Does not present enough evidence to support the argument for the choice of the model	Clearly articulates a position or argument for the choosing software engineering models. Presents sufficient evidence to support argument for the model selection	
Role identification and Responsibility Allocation	The project has poor project management plans for identifying roles and assigning the responsibilities	Identify few roles in the project management where some of the roles are left alone with any project responsibilities	Identify most of the roles in the project management and assign their responsibilities	Well planned project with proper role identification and responsibility allocation in the project management activities	
Impact identification	Student vaguely discuss the impact of societal, health, safety, legal, cultural, or environmental issues in their project	Student provided with partial relevance to the impact of societal, health, safety, legal, cultural, or environmental issues in their project	Student fairly provided the analysis to the impact of societal, health, safety, legal, cultural, or environmental issues in their project	Student comprehensively provided the analysis to the impact of societal, health, safety, legal, cultural, or environmental issues in their project	
Formatting and Submission	Project report is not complete and Several errors in spelling and grammar. Present a Confusing organization of concepts, supporting arguments, and real-life example. Sentences rambling, and details are repeated.	Some errors in spelling and grammar. Some problems of organizing the answer in a logical order of defining, elaborating, and providing real-life examples.	Few errors in spelling and grammar. Presents most of the details in a logical flow of organization in definition, details, and example.	Project report is complete and No errors in spelling and grammar. Consistently presents a logical and effective organization of definition, details, and real-life example of the topic.	

Acquired marks:	
CO Pass / Fail:	

Rubric for Project Assessment (CO4)

Marking Criteria	Marks Distribution (Maximum 3X5=15)				Acquired Marks
	Missing/ Incorrect (0-1)	**Inadequate (2)**	**Satisfactory (3-4)**	**Excellent (5)**	
Project Planning	Missing or incorrect project plan;	Insufficient project plan provided: project team, project tasks, goals etc. stated poorly.	Sufficient information provided : project team members, their tasks, project plan discussed in details.	Thorough and relevant project plan is provided; project plan is clear and easy to follow.	
Effort Estimation and Scheduling	Missing or incorrect effort estimation or schedules based on available project resources	Insufficient or poorly stated effort estimation or schedules based on available project resources	Correct or sufficient technique used for effort estimation or schedules based on available project resources	Project estimation was described using proper effort estimation or schedules based on available project resources	
Risk Management	Risk analysis activities were missing or inappropriate for the specific project: unidentified risks or wrongly categorized risks or not prioritized properly.	Risks are partially identified(insufficient) and not properly categorized or not prioritized properly.	Sufficient and critical risks are identified(insufficient) and properly categorized but not prioritized properly.	Sufficient and appropiate risks are identified, analyzed, and properly categorized or prioritized.	
				Acquired Marks:	
				CO Pass / Fail:	