



**Middlesex
University
Dubai**

PDE2101

**Engineering Software Development:
IFitXplore Studio**

PROJECT REPORT PROPOSAL

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ABSTRACT

IFitXplore Studio is a system that integrates IoT, hardware and software to assist gym goers in making their workout routines more effective and help them reach their fitness goals. We introduce a novel idea that involves sensors installed on equipment, which will interact with every users' wearable devices and transmit their activity information to a secure cloud-based database. This information can be accessed through an interactive mobile application. Personalized workout plans will be offered on this application, along with view of real-time availability of machines, and a chatroom.

INTRODUCTION

The Internet of Things technology (IoT) extends the internet by connecting physical sensors to it, that take inputs from its environment. It has been applied in a vast number of areas – home, industrial applications, healthcare, etc. Although, it has not yet reached the most popular zone people go to improve their strength and body – the gym (Yong, 2018). There are numerous applications on the Play Store to track progress, but they require users to manually enter data each time. Wearable devices were the no. 1 trend in the fitness industry, according to a worldwide survey taken last year (Thompson, 2022), but their usage tends to halt within 6 months or lesser - since they just display data, with little engagement (Alce, 2021).

In this report proposal, we present a comprehensive outline of our project, from its inception to the practical implementation and ethical considerations. As we delve into the project's various components, features, and methodologies, we aim to demonstrate how "iFitXplore Studio" can bring a paradigm shift to the world of fitness, offering an environment that empowers individuals to achieve their fitness goals efficiently and effectively.

PROBLEM DEFINITION

Many people face challenges in their fitness journey - not knowing how to use equipment properly, struggling to track their progress, etc. These problems can negatively affect their health & motivation. Our proposed project, "iFitXplore Studio", utilizes this technology to change the gym-going experience. We will integrate IoT devices with already existing equipment which can track usage, and parameters like speed or count. Their health data will be collected by a wearable device, which will also link them to the machine they're currently using. Our system supports gym users with real-time view of equipment availability, track of their daily workouts, and personalized workout plans, among many other features.

In this proposal, we will delve into the intricacies of the "iFitXplore Studio" project, outlining its objectives, functionalities, and the significant benefits it offers to both fitness enthusiasts and gym operators. We will explore the technological framework, user experience, data, and more, showcasing how this project can be a game-changer in the fitness industry.

DESCRIPTION

First, we incorporate sensors into existing equipment, with a microcontroller board that connects with everything and wirelessly sends collected data to the database in the cloud. The cloud stores user information (name, email, height, etc.), their daily activity data (which exercises were performed for how long), equipment status (available or not), and chat histories. These can be viewed & some can be edited on the mobile application. Using this data, each user gets a generated workout plan based on their health & goals, which they can further edit if desired. There is an availability page that shows which machines are occupied and which are not. There is also a chatroom to connect with other users of the gym. Together, they help accelerate the progress of user health and improve their whole experience.

Aims & Objectives:

This project involves the design & development of an innovative IoT and hardware-based solution to create a technologically advanced and user-friendly gym environment. The implementation of this system aims to increase user convenience by showing current status of equipment and have tutorials of how to use each equipment on their fingertips. We take into consideration their health issues in order to develop plans that benefit their body & does not cause harm. Workout data is collected for the use of giving feedback on their progress. Finally, the chatroom intends to stimulate healthy conversation. Overall, the system's purpose is to empower users by giving them insights into their growth, among many other features that saves their time & makes them feel connected & efficient in achieving their goals.

Benefits of the Project:

Our “iFit Xplore Studio” project offers a comprehensive, user-centred solution that transforms traditional gym experience and management into a modern, data-driven, supportive fitness journey. It empowers gym-goers to reach their fitness goals efficiently.

Based on the given data, users will instantly have a tailored made schedule planned out for them. They can plan their timings by viewing the current status of all machines remotely, reducing waiting times, congestion and disturbance. On the other hand, gym management gains valuable insights into equipment usage, enabling efficient resource allocation and maintenance.

Additionally, the application offers chat rooms where they can communicate with like-minded members, and helps promote users' consistent participation. Online fitness community engagement is critical to the successful adoption of the system, and continued usage (Hu et al., 2023).

This project improves the overall gym experience, making it more efficient, enjoyable, and safer. It also has the potential to boost gym membership retention, enhance customer satisfaction, and optimize gym operations.

Functional and Non-Functional Requirements:

In the development of the "iFitXplore Studio" project, a set of well-defined functional and non-functional requirements has been established to guide the system's design and implementation.

Functional Requirements -

- When the watch is tapped on the RFID module on the machine, the user and the machine will become linked, and the machine will be displayed as occupied on the availability page of the application.
- The user is supposed to tap their watch at the beginning & end of each use of equipment, so that the system records their progress correctly. If they forget to do so in the beginning, this data will not be added to their records. If they tap at the beginning but forget in the end, the system will switch connections if another user is detected, or disconnect after 1 hour from the beginning.
- The watch should also show next workout from the plan on the watch, so users don't have to take out their phones every time.
- The availability page will show a graphical representation of the area with occupied machines with a red hue, and available ones with green. The page may also show closed, according to the timings of the facility.
- Real-time workout tracking is a fundamental feature, allowing the system to capture data on exercise type, duration, and other relevant metrics.
- Basic health data like heart rate & spO2 will be monitored, and will beep if it exceeds a normal range, bringing immediate attention. These will also be visible to the user on the application.
- Users must log into their account on the mobile application to use its features. New users will have an option to register, choose membership plans & pay.
- Users should be able to edit or delete their personal information from the system at any time. Collected data will include name, ID, address, phone, email, height, weight, health conditions, etc.
- Personalized workout plans using robust algorithms are another key functionality, as the system must generate plans tailored to individual fitness goals, capabilities, and

preferences. So users must be able to input their timings and should be able to add or remove exercises from the plan.

- There will be written & video instructions to educate users on the proper techniques of using each equipment.
- Performance feedback, i.e. daily progress in comparison to the workout plan will keep the user informed of their activities.
- User interaction and support are facilitated through a chat room, fostering a sense of community - where users can connect with one another, and share their journeys. Group chats will also be made an option.
- Users will be reminded when their membership is nearing expiration.
- Word embeddings will be analysed to detect inappropriate language used in the chatroom, ensuring a positive environment for users.
- The application will also have an announcements section, for the gym management to inform users of any upcoming events taking place at the gym. Management accounts will be given the feature to add these.
- There will be options to report faults & complaints on all pages of the application, where their messages will be sent to one of the management accounts.

Non-Functional Requirements -

- Reliability is a crucial aspect, ensuring minimal downtime or disruptions, as users must be able to rely on the system for consistent, timely and accurate data tracking.
- Performance is a key non-functional requirement, as the system must operate efficiently, providing real-time information without noticeable delays, thus ensuring a smooth and uninterrupted user experience.
- Scalability is also essential, with the system designed to handle an increasing user base. As more users engage with the system, it should be able to scale accordingly to accommodate the growing data and user interactions.
- Security is paramount, and the system will be implemented with robust measures such as access controls to protect user information from unauthorized access, and data theft.

- Usability is a non-functional requirement that emphasizes the user-friendliness of the system - an intuitive interface, allowing gym-goers to easily navigate and utilize its various features.
- Regular maintenance, monitoring, feedback mechanism and more will be implemented to ensure proper functionality & user satisfaction.
- Placement of the hardware should not interfere with the usage of the equipment, i.e. one should be able to normally use it like before.
- The wearable device must be compact enough to comfortably wear during workouts.

Research Methodology:

A combination of exploratory & applied research is being conducted during this project, to observe potential areas of improvement & apply new & innovative technology to address them. Some descriptive & quantitative research is being done to observe trends, opportunities & challenges in the IoT industry. A particular focus is placed on applications related to the fitness sector, allowing for a deeper understanding of the landscape, and facilitating better-informed decision-making throughout the project lifecycle.

We must also look for the right components for this task and choose specific hardware for each type of machine. Some portable equipment will be brought to demonstrate the hardware on. We also must figure out how components will communicate with each other.

Development Methodology:

Agile methodology, and more specifically the scrum framework has been chosen for the realization of this project. It was considered most suitable, since this task involves many small components. It will be easier to debug & upgrade if we develop them as separate pieces and integrate them later. Thus, we have divided the process into 8 sprints, over the course of 6 months. This idea of implementing IoT into gyms is new, so we are at the early stages, and changes are bound to come up. The fast & progressive pace and test-driven nature of agile development will accelerate the pace of this project's implementation, and produce a quality

product (Dingsøyr, 2012). The team will be having weekly meetings to update their progress, plan the next course of action, fix bugs, etc.

Ethical Issues:

While the "iFit Xplore Studio" project aims to enhance the fitness experience of gym-goers through IoT technology, it also raises significant ethical considerations. As the system collects and stores a wealth of user data, including workout information and medical details, it is imperative to guarantee the utmost security for this sensitive information in compliance with data protection regulations.

Users should be well-informed about system updates, how their data is collected and, more importantly, how it is employed within the system. The hardware and sensors used in the system must provide precise and reliable data. Inaccuracies could not only lead to incorrect workouts but may also pose risks to users' health.

We will use third-party videos to show proper techniques for using each piece of equipment. So, permission must be taken from the original creators before we put them into our application.

We will establish clear privacy data management features such as privacy policy, authorization, email requests, password protection, and registration for enabling navigation to the app. In addition, we can include trust-based features such as backing from credible sources and feedback options in case one wants to contact the team regarding queries, suggestions or functional issues (Galetsi, 2023). This approach will build user trust and foster the project's long-term success and positive impact on the fitness community.

DELIVERABLES

Our project, "iFit Xplore Studio," is committed to achieving specific deliverables that align with our objectives and ethical considerations. Our primary focus is the discreet integration of IoT technology and hardware with existing equipment. This includes the strategic placement of sensors, allowing them to interact with users' wearable devices seamlessly.

The innovative wearable devices being proposed will establish a connection between users and machines, allowing for the continuous monitoring of their health and the tracking of their progress over time. Along with their health parameters, the watch will display the exercise next in line, according to their plan.

Furthermore, our project involves delivering personalized workout plans based on their body and health conditions on our mobile application that cater to individual fitness goals, capabilities, and preferences. We recognize the importance of emotional support in a gym environment, and our features, including a chat room, will promote user interaction and increase motivation and encouragement. Simultaneously, we strive to optimize equipment usage by displaying which equipment is occupied and which is engaged in real time.

This Project Proposal encompasses our aims and visions for this project, the methods we will use to realize it, all the features to be included, and the tools to do so. After the implementation over the next few months, we will demonstrate the working, fully integrated system and submit another well-documented report, including various UML diagrams to explain the functionalities of our project clearly.

We will be providing the complete source code for both the microcontroller software and the associated application software. The database that stores all the user information, machine status and chat history will also be given.

Collectively, these deliverables contribute to our project's overarching objectives: enhancing the gym experience, prioritizing user well-being, and improving operational efficiency. Our team is dedicated to diligently working toward these goals to create a successful and ethically sound fitness environment for all users.

RESOURCES

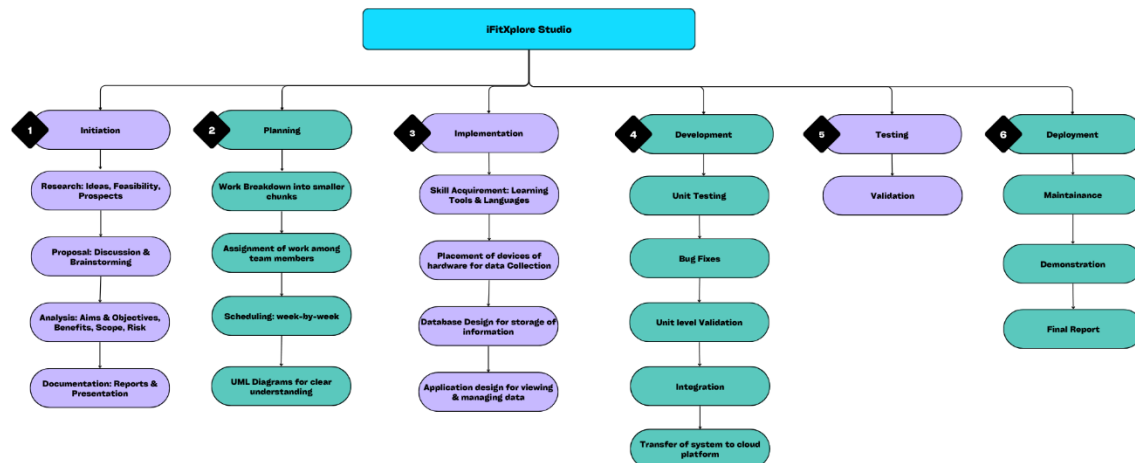
Hardware:

- The Arduino UNO development board is an open-source, programmable and customizable device, perfect for the sensors via the I/O pins to take inputs from the equipment and communicate with the watch and cloud. It will also be used for the wearable device.
- A Wi-Fi module must be added to the microcontroller board for wireless connection.
- An RFID module (Radio Frequency Identification) will be used to identify each user.
- A variety of sensors will be used for this project. Each equipment is different, and is used differently, so each piece of hardware will be appropriately chosen for each of them. Eg.: IR sensors will be used to detect & calculate the speed of the treadmills, and motion sensors will be used to count repetitions of dumbbells.
- Health-indicating sensors will be added to the wearable device, like spO2 & pulse.
- A screen to display current health stats & next workout on the device
- Breadboard & wires
- Batteries to power the board & modules

Software:

- The Arduino IDE will be used to program the board in C++.
- The Flutter SDK & its language, Dart will be used to develop the mobile application.
- TinkerCAD will be used to test the components & connections of the Arduino board.
- Google Cloud's services will be used to store data.
- MS Word is being used for documentation purposes.
- MS Project, Canva & Creately are being used for creating UML diagrams to represent our system in a simple way.

WORK BREAKDOWN STRUCTURE



SCHEDULE

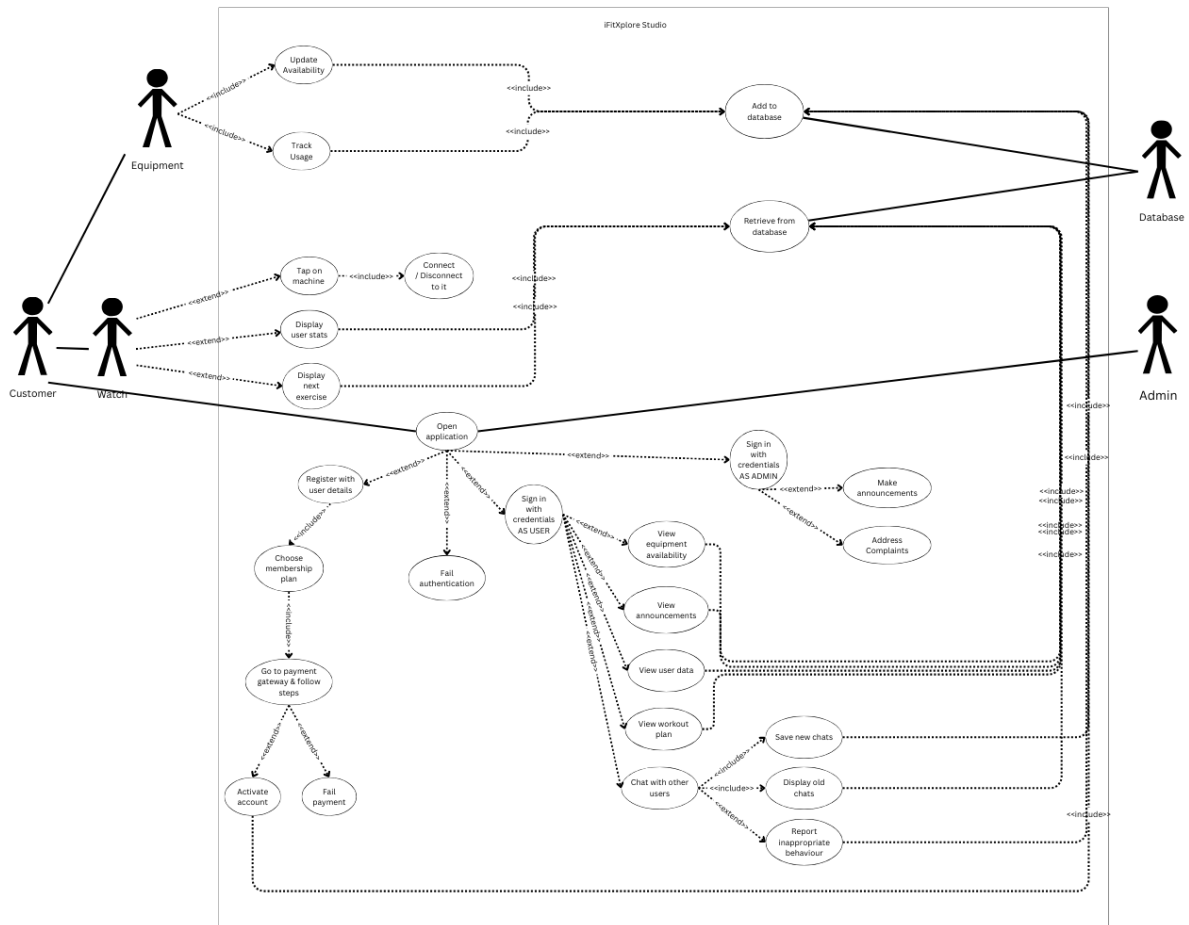
Task Name	Duration	Start	Finish
FitXplore Studio	100 days	Tue 17/10/23	Sun 03/03/24
1. Project Approval	14 days	Tue 17/10/23	Fri 03/11/23
2. Documentation	87 days	Fri 03/11/23	Sun 03/03/24
3. Proposal Presentation	4 days	Fri 03/11/23	Wed 08/11/23
4. Development Phase 1	26 days	Mon 06/11/23	Sun 10/12/23
4.1. Research & decide detailed Plan of Action	6 days	Mon 06/11/23	Sun 12/11/23
4.2. Acquire required skills needed to proceed	26 days	Mon 06/11/23	Sun 10/12/23
4.3. Decide Component List & Order	6 days	Mon 06/11/23	Sun 12/11/23
4.4. Eqpt. Hardware Dev.	21 days	Mon 13/11/23	Sun 10/12/23
4.5. Basic App Design & Dev.	6 days	Mon 27/11/23	Sun 03/12/23
5. Testing Phase 1	6 days	Mon 11/12/23	Sun 17/12/23
5.1. Test Eqpt. Hardware	4 days	Mon 11/12/23	Thu 14/12/23
5.2. Check accuracy of Readings	4 days	Mon 11/12/23	Thu 14/12/23
5.3. Validate app pages	2 days	Fri 15/12/23	Sun 17/12/23
6. Development Phase 2	21 days	Mon 18/12/23	Sun 14/01/24
6.1. Functional App Dev.	11 days	Mon 18/12/23	Sun 31/12/23
6.2. Cloud DB Setup	11 days	Mon 25/12/23	Sun 07/01/24
6.3. Watch Software Design & Implementation	11 days	Mon 01/01/24	Sun 14/01/24
7. Testing Phase 2	6 days	Mon 15/01/24	Sun 21/01/24
7.1 App Testing & Validation	4 days	Mon 15/01/24	Thu 18/01/24

7.2. Cloud DB Testing	2 days	Fri 19/01/24	Sun 21/01/24
8. Development Phase 3	11 days	Mon 22/01/24	Sun 04/02/24
8.1. Watch Hardware Design & Implementation	6 days	Mon 22/01/24	Sun 28/01/24
8.2. Chatroom Dev.	6 days	Mon 29/01/24	Sun 04/02/24
9. Testing Phase 3	6 days	Mon 05/02/24	Sun 11/02/24
9.1. Check watch Performance	4 days	Mon 05/02/24	Thu 08/02/24
9.2. Test chatroom features	2 days	Fri 09/02/24	Sun 11/02/24
10. Development Phase 4	11 days	Mon 12/02/24	Sun 25/02/24
10.1. Integration	11 days	Mon 12/02/24	Sun 25/02/24
11. Testing Phase 3	6 days	Mon 26/02/24	Sun 03/03/24
11.1. Integrated Testing	3 days	Mon 26/02/24	Wed 28/02/24
11.2. System Validation	3 days	Thu 29/02/24	Sun 03/03/24

GANTT CHART



USE – CASE DIAGRAM



CONCLUSION

In conclusion, our project stands to revolutionize the gym industry, benefiting both gym-goers and management alike while upholding ethical standards. By seamlessly integrating IoT technology, hardware and software, we tackle the industry's pain points head-on. Users will enjoy personalized workout guidance, increased motivation, and equipment optimization. Furthermore, our system provides a platform to connect with one another. In a nutshell, our project not only enhances the overall gym experience, making it more efficient, engaging, and safer, but also improves membership retention, elevates customer satisfaction, and optimizes gym operations.

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