Online Activity No. 8 and 9: Applying the User-Centred System Design Process

Objective

1. Innovate an existing interactive system and computer technology.
2. Perform and apply UCSD.

Materials

- Personal computer
- Any software for (Computer aided designs)or programming language

Background

Atakan(2006), UCSD is used in the design process. Reasons are evaluated why traditional-technology-focused design processes why it may result in unusable systems-and the consequences of those unusable or useless systems. This leads directly to a consideration of the different methodologies that go to make up a user-centered system design process.

Procedure

a.) Identify a scope or agenda
b.) Format for the document is given below as guide for the designers in the making the output both the document and design.

Chapter I. Introduction

Background of the study

Kitchen-related accidents are one of the most common problems in every household because there exist plenty of hazards within the environment. Hazards such as gas leaks, unattended stove tops, and open flames pose serious danger. One of the most vulnerable demographics exposed to this danger is the elderly, especially those living alone and suffering from age-related problems. Although there have been advancements in home safety technologies, many of the existing systems are either too expensive or too complex for elderly users to use.

To address this issue, we propose the development of Kitchen Sentinel, a smart safety monitoring system designed specifically for elderly individuals. This system integrates affordable IoT components to detect gas leaks, monitor stove activity, and sense user presence in the kitchen. It provides both local and remote notifications for both the elderly users and caregivers, while requiring minimal user interaction.

Statement of the problem

1. **Elderly individuals are prone to causing kitchen incidents due to age-related issues such as memory loss and reduced mobility.**
   These limitations increase the risk of leaving stoves unattended, failing to detect gas leaks, or reacting slowly to emergencies in the kitchen.

2. **Existing safety systems for kitchens are too complex, expensive, or inaccessible to non-tech-savvy users.**
   Elderly users struggle to operate modern safety technologies, which often require advanced setup or smartphone use, making them ineffective for this demographic.

Assumption of the study

The proposed Kitchen Sentinel system will address the after mentioned problems through the following:

- **Gas Leak Detection**: The system utilizes an MQ-2 sensor to monitor LPG levels and detect leaks automatically.
- **Stove Activity Monitoring:** The system uses a temperature sensor to identify if the stove is left unattended.
- **User Presence Detection**: The system uses a PIR sensor to check if someone is near the stove.
- **Local Alerts**: The system uses buzzers and LEDs to provide audiovisual warnings and alert users about potential hazards.
- **Remote Notifications**: The system utilizes an ESP32 module to send real-time alerts to caregivers or family members.
- **Manual Override Button**: The system allows users to acknowledge and silence alarms easily without the need to use a smartphone.
- **Mobile Application**: The system includes an app where users and caregivers can monitor real-time sensor data, receive alerts, and adjust basic settings such as notification preferences and system status.

These features validate the assumption that the proposed Kitchen Sentinel system can effectively improve kitchen safety for elderly individuals through affordable and easy-to-use technology.

Significance of the study

1. Elderly Individuals
   - Enables independent living while maintaining safety in the kitchen.
2. Caregivers/Family Members
   - Allows remote monitoring and quick response to kitchen-related hazards.
3. Elder Care Facilities
   - Enhances safety standards and reduces incident risks.
4. Researchers
   - Provides a model for affordable, user-centered assistive technologies.
5. Government and NGOs
   - Promotes inclusive safety measures for vulnerable communities.

Chapter II. Research Design

The research design used by the developers in this project proposal is the User-Centered System Design (UCSD) model, because it ensures that the users' needs, wants, and expectations are met, and that a successful, intuitive, and relevant system is created to address the users' problems.

A. Task Analysis

The primary tasks performed by the system are the following:

- Monitoring stove activity (automated via temperature sensor).
- Detecting gas leaks (automated via MQ-2 sensor).
- Sensing user presence (automated via PIR sensor).
- Issuing alerts through buzzer and LED (local alerts).
- Sending remote notifications to caregivers via Wi-Fi.
- Displaying real-time alerts and system status via mobile application.
- Silencing alarms using the manual override button.

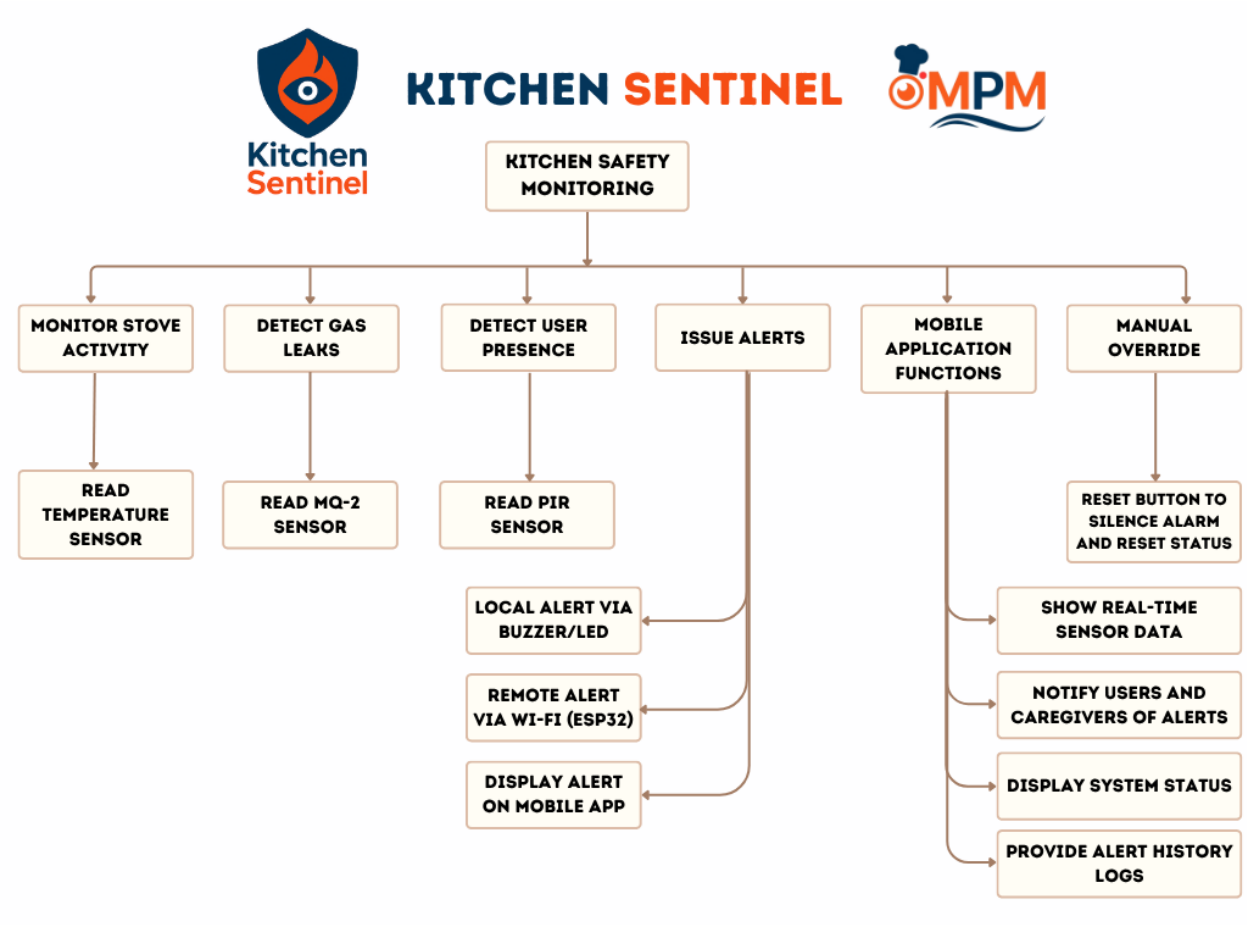

Figure 1. Hierarchical Task Analysis

B. **Requirements Gathering**

The following methods were utilized by the proponents to gather the necessary data needed in creating the proposal:

1. **Observation**: The proponents observed and identified problems faced by elderly individuals living alone in a household setting.
2. **Second-hand Research**: The proponents conducted research on the issue and reviewed existing literature, case studies, and related technologies to better understand the situation regarding kitchen safety and the limitations of existing solutions.

User Requirements

- Easy-to-understand alerts
- Reliable notifications
- Minimal or no interaction needed

Functional Requirements

- Detect gas concentration
- Identify stove activity
- Identify motion
- Trigger alerts

Data Requirements

- Sensor readings (gas levels, temperature, motion)
- Timestamped alerts

Environmental Requirements

- Indoor and domestic kitchen environment
- Access to Wi-Fi

Usability Requirements

- Clear audiovisual feedback
- Simple reset button

Designers Requirements

- Use inexpensive sensors
- Compact and suitable design for kitchens
- Must run continuously with minimal maintenance

C. **Storyboarding and Prototyping**

Storyboarding

The storyboard illustrates the user's interaction with the Kitchen Sentinel system. It highlights key features such as receiving alerts, confirming notifications, checking the situation, reviewing history, and adjusting settings for a personalized experience.

Figure 2. Storyboard

Prototyping

Opening Application – Users will see the Kitchen Sentinel logo displayed prominently upon launching the app.

Dashboard – Users see a clean, intuitive layout showing three core detection functions: Gas, Fire/Heat, and Motion. Each is marked with a clear icon, and visual alerts appear beside any active threat. 'Activity Log' and 'Settings' buttons provide quick access to event history and customization.

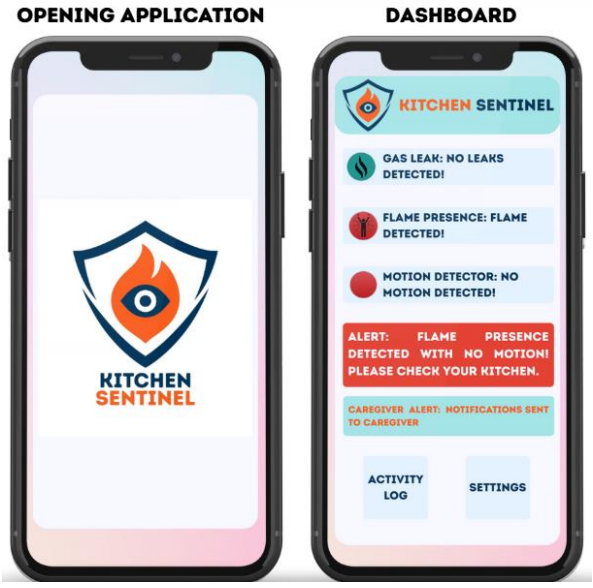

Figure 3. Loading and Dashboard Screens

Activity Log - Users can view a chronological list of all past alerts and system events. Each entry includes a timestamp, making it easy for users or caregivers to review and verify specific incidents.

Settings - In the Settings page, users will be able to manage notifications, test the sensors, add or update a caregiver number, access and edit their emergency contact list, switch between light and dark mode, adjust the font size for better readability, and access the Help Center for support and frequently asked questions.

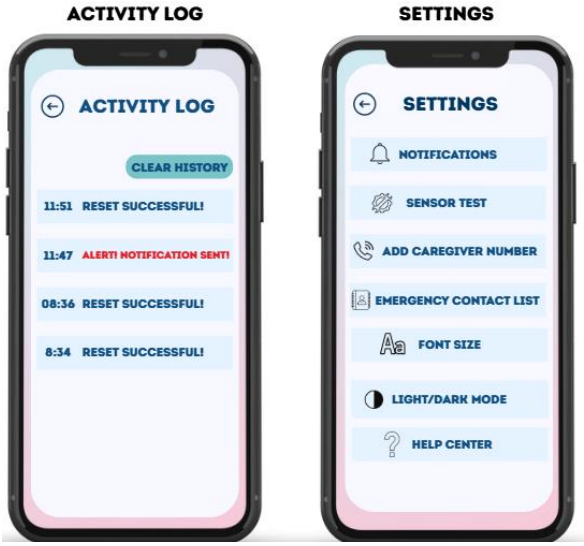

Figure 4. Activity Log and Settings Screen

Pop-Ups – Users will see pop-up prompts when performing important actions such as clearing the history or adding a new contact number. These pop-ups ask for confirmation and include Cancel and Yes buttons to proceed or cancel the action.

Notifications – Users will receive real-time alerts when the system detects critical events. These notifications appear at the top of the screen and are designed to be clear and readable, helping users take immediate action.

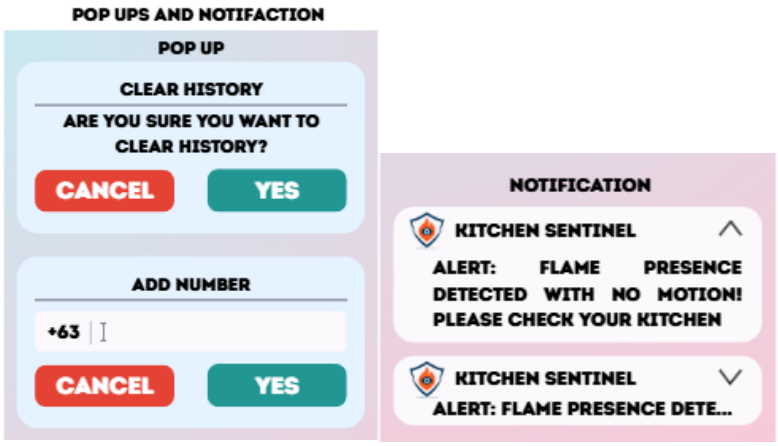

Figure 5. Pop-ups and Notifications

D. **Evaluation of prototype**

Area of Evaluation	5	4	3	2	1
A. Visibility of System Status - The system design provides appropriate feedback like message prompts in response to user actions.		x			
- The message prompts are clear, visible and understandable.		x			
B. Match between the system and the real world - Used words, phrases and concepts according to users' language rather than system oriented words and computer jargons.		x			
C. User control and freedom - The system design provides ways of allowing users to easily "get in" and "get out" if they find themselves in unfamiliar parts of the system.		x			
D. Consistency and Standards - The colors, text, labels, buttons and other elements in the design are uniform from start to finish**.**		x			
- Text and icons are not too small or too big.		x			
- Menus and other features of the system are arranged and positioned in a consistent way. (For ex. If your website has navigation buttons on the top under the page title on one page, the users will automatically look there for the same features on other pages.	x				
E. **Error Prevention** - The system design provides an automatic detection of errors and preventing them to occur in the first place.		x			
- Idiot proofing mechanisms are applied		x			
F. Help users recognize, diagnose and recover from errors **-** Error messages and the terms used are recognizable, familiar and understandable for the users.		x			
G. Recognition rather than recall **-** Objects, icons, actions and options are visible for the user. - Objects are labeled well with text and icons that can immediately be spotted by the user and matched with what they want to do.	x				
H. Flexibility and efficiency of use - The system design provides easy to navigate menus. - the system does not make wasteful time of system resources.	x				
I. Aesthetic and minimalist design **-**Graphics and animations used are not difficult to look at and does not clutter (mess) up the screen. - Information provided is relevant and needed for the system design.	x				
J. Help and Documentation	x				

-the system design provides information that can be easily searched and provides help in a set of concrete steps that can easily be followed.					

Chapter III. Conclusion and Recommendation

Conclusion:

The development of Kitchen Sentinel tackles essential kitchen safety concerns for the elderly, particularly those who live independently. By combining user-centered design principles with low-cost Internet of Things (IoT) components, the system provides a practical and cost-effective solution. Through features such as gas leak detection, stove monitoring, and user presence sensing, the system proactively minimizes hazards that commonly lead to kitchen-related accidents.

Kitchen Sentinel's design emphasizes ease of use, particularly for non-technical users. Audiovisual alerts, a manual override button, and remote notifications via mobile application keep both users and caregivers aware and able to respond quickly to any accidents.

This project not only solves a real-world problem but also highlights the need to use Human-Computer Interaction (HCI) principles to develop inclusive technology. The researchers acquired hands-on experience designing with empathy, recognizing user restrictions, and refining a product based on functional and usability criteria.

Recommendations:

- **Offline Functionality -** Incorporate data caching and offline alerting capabilities in case of Wi-Fi outages, ensuring continued safety even without connectivity.
- **Integration with Smart Home Ecosystems -** Allow the system to interact with existing smart devices such as smart plugs or fire suppression systems for added protection.
- **Battery Backup and Power Monitoring -** Equip the system with a battery backup to maintain functionality during power outages and add power usage tracking.
- **Custom Alert Preferences -** Allow caregivers or users to customize alert thresholds or choose preferred modes of notification such as calls, SMS, or the app itself.