Systems Architecture and Design Assignment 2

Software Architecture Proposal (Team-based)

Smart Emergency Response System (SERS)

Authors

Sandesh Mangat: s3945006

Vidhathra Dharan: s3944867

Nipuna Samaraeera Arachchige: s4075255

Goal

RMIT smart emergency response system, or SERS for short, aims to provide a real-time AI-supported platform. SERS is a platform that enables the detection, assessment, and management of incidents and emergencies across RMIT campuses globally. Incidents such as fires, medical emergencies, security breaches, gas leaks and even severe weather will be monitored by the system with AI-driven decision support, IoT sensors and live video feedback. SERS coordinate responses to maximise safety and de-escalate the situation by enabling instant communication between student staff and emergency services by sending mobile alerts and providing indoor navigation to exits. RMIT as a community will have enhanced situational awareness to ensure response times are reduced, and any alerts can be mitigated and de-escalated as soon as possible.

Stakeholders

Role/Name	**Expectations**
Students	Receive quick emergency alerts and clear and concise evacuation instructions when needed
Staff Members	Access to emergency alerts and evacuation routes to support students and other staff in need
RMIT Security	Monitor incidents in real time, able to alert quickly and monitor alerts/incidents in real time with the ability to communicate with other staff or emergency services
Emergency Services	Requires real-time updates on any alerts that have been raised, direct communication with RMIT Security and access to building maps to enable faster response and efficient evacuations
IT department	A reliable and secure system that can support multiple alerts concurrently with minimal downtime
RMIT Management	Improve campus safety that meets all the security and compliance standards while being cost-effective.

Requirements

Functional Requirements

ID	Description (max 30 words each)
FR-01	The system should send alerts to the mobile devices of relevant students and staff
FR-02	IoT smoke sensors should be integrated into the system to detect fire hazards and take appropriate action.
FR-03	Indoor navigation – the system needs to guide students/staff to safety or the nearest exit.
FR-04	Gas leak sensors must be integrated with the systems so they can detect and send alerts.
FR-05	Weather conditions need to be monitored in real time so the system can detect and alert to any severe weather conditions, such as storms or floods
FR-06	Medical emergencies – the system should allow staff and students to report an incident or contact a designated medical team for help
FR-07	Sensor status – the system should do routine checks on sensors and communication systems to ensure they run as intended.
FR-08	AI support should analyse the past emergencies to manage way the system responds and improve strategies in taking the safest option
FR-09	Multi-language support – In a multicultural university setting, students and staff should be able to select the language they want alerts and app information to be.
FR-10	External emergency support – the system should initiate contact and alert local emergency services, such as ambulance or fire department, depending on the severity of the situation.
FR-11	If the initial response by the system fails to manage the situation, the system should employ protocols that are designed to de-escalate the situation as fast as possible.
FR-12	User Location – the system keeps track of student/staff location to aid in navigation and locate any users that may need additional assistance
FR-13	Location Alerts – alerts should only be sent to users who are in proximity to the emergency and minimise unnecessary notifications. E.g. students in the city campus should not get notifications about minor incidents or alerts from the Bundoora campus.

FR-14	User connectivity and battery status – during an evacuation, student/staff status should be monitored in real time to check if devices are online/offline and keep note of the last known location, especially if their battery is low.
FR-15	Feedback after an incident should be taken by the system and assessed to improve protocols, evacuation plans, and overall effectiveness of how the situation was handled.

Non-functional Requirements

ID	Category of Quality Attribute	Description (max 30 words each)
1	Performance, Elasticity	Alerts and data should be quickly processed so that action can be taken as soon a possible.
2	Scalability, Elasticity	Growth in the number of sensors or users should be supported so that the system can efficiently operate even if the campus becomes bigger.
3	Security	Encryption methods should be utilised to ensure sensitive data is kept private and to prevent unauthorised communications to the system.
4	Reliability	The system should run with minimal interruptions to prevent crashes during emergencies or incidents.
5	Availability, Reliability	Uptime of 99.99% should be guaranteed so that the system is functional during an emergency.
6	Accessibility, Compliance	Interfaces should support assistive features so that it is inclusive for users with disabilities and comply with accessibility standards.
7	Recoverability, Availability	If a failure or crash were to occur, the system should restore functionality as soon as possible to ensure its ability to manage incidents quickly.

8	Maintainability	Updates should be easy to install, and any bug fixes should be done while keeping downtime to a minimum with minimal disruptions.
9	Error Handling, Availability	System errors or any errors in sensors should be detected quickly and resolved so that the system can be reliable and available during emergencies.
10	Compatibility, Usability	The system should integrate well with existing technologies on campus and accommodate future tech so that functionality across campus is smooth and coordinated with existing systems.
11	Usability	UI design should be intuitive to accommodate students and staff from all over the world and allow everyone to navigate the system easily.
12	Portability, Accessibility	System operations should be well-designed and accommodate different device types, such as laptops or phones, so that users can receive alerts and send incident reports easily.
13	Latency, Availability	Communication should have minimal delay for real-time incident response and data processing, which will be necessary in emergencies.
14	Compliance	The system should meet legal requirements that fulfil safety and data regulations, especially since it's used by RMIT and needs to be trustworthy.
15	Reliability, Elasticity	During network stress, high-load periods, the system should not be disrupted and continue to manage and detect emergencies.

Quality Attributes (Architecture Characteristics)

Top 3	Driving Characteristics (QAs)	Implicit Characteristics (QAs)
✖	Availability	*Feasibility*
	Elasticity	*Security*
	Scalability	*Maintainability*
✖	Reliability	*Observability*
	Performance	
✖	Responsiveness	
	Extensibility	**Other architectural characteristics considered**
		Upgradeability Usability

Architecture Characteristics	Rationale
Availability	The system should remain operational even during heavy traffic and have a minimum downtime to ensure that communication is not interrupted.
Reliability	The information and services provided by the system should be accurate since users use this service in very critical situations.
Responsiveness	The system must react to the user requests in real time through notifications, videos and other types of updates and minimise delays in emergency response.
Elasticity	Since most of the emergencies are quite unpredictable, the system should be able to handle sudden spikes in user requests without significant delays.
Scalability	The system should be able to expand to support other ventures, a lot of devices and more new users without degrading the performance.
Performance	The system should be capable of handling high traffic and be able to respond fast to user requests and conduct live video streams efficiently.
Extensibility	The system should support integration of new features without major redesigns and without impacting existing features. It should adapt to evolving emergency needs.

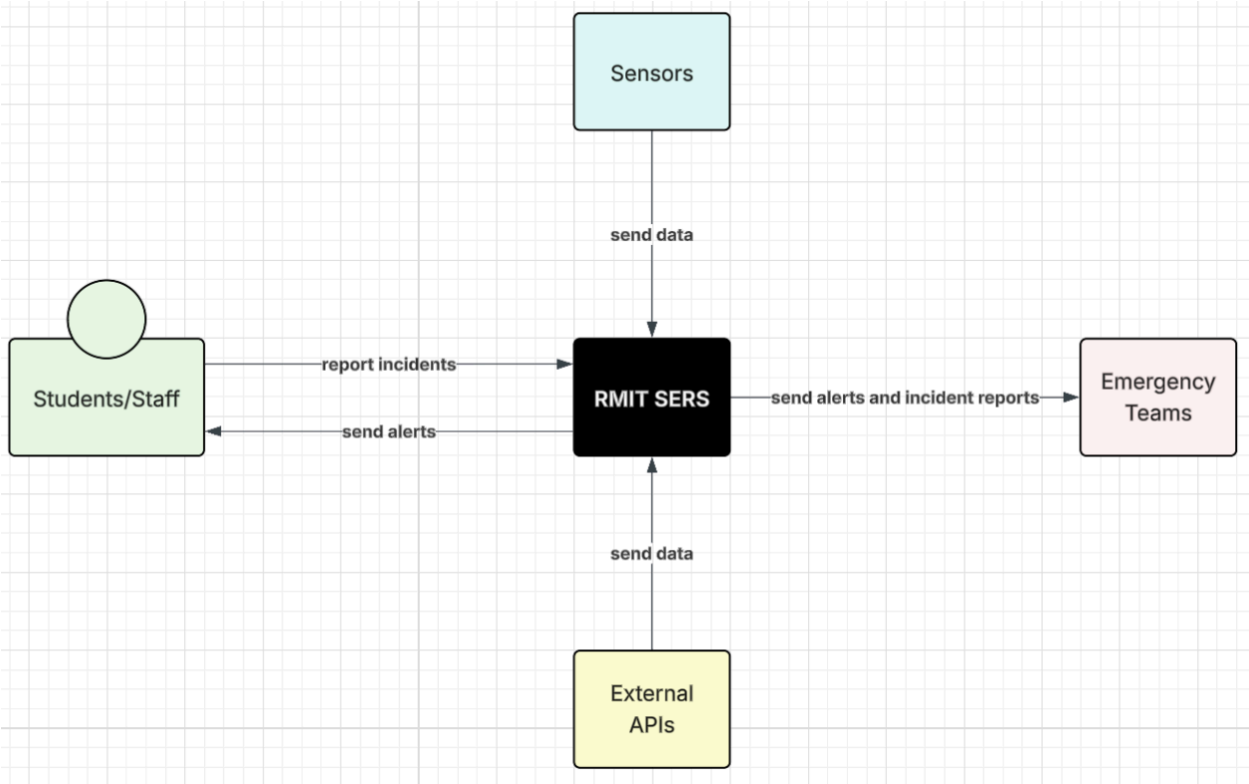
Upgradeability	The system should allow software and hardware upgrades, like new AI models and sensors, without interrupting the ongoing services. The performance should not be affected.
Usability	A variety of users, such as students and staff, should be able to use the system easily because most users tend to use the system in stressful situations.

Constraints

Constraint ID	**Description**
Constraint - 1	The system should adhere to the rules and regulations related to cyber security and data protection including GDPR considering the sensitivity of the user information.
Constraint - 2	The system should provide multilingual support in all the premises of RMIT university to make sure that information is communicated accurately and efficiently with users.
Constraint - 3	The system must operate on multiple platforms such as Windows, Android, IOS, etc. ensuring that the system functions consistently in emergencies.
Constraint - 4	The system must be integrated with external emergency services like police, fire and ambulance services and should communicate with them efficiently during emergencies.
Constraint - 5	The system should comply with RMIT university’s safety policies and protocols to make sure that all the actions taken by the system align with the established procedure.

System Context Diagram

C4 Model's System Context Diagram



Elements/Nodes	Description (30 words)
RMIT SERS	The Smart Emergency Response system, where data from sensors is analysed for threats as well as incident reports. Takes actions by sending alerts and going through emergency protocols.
Students/Staff	Student and staff personnel can report incidents and receive alert notifications from the system, so they can be well-informed and receive guidance if needed.
Sensors	Sensors, including IoT devices, will send real-time data containing potential hazards to the system, which then determines if action is required.
External APIs	Third-party services like weather forecasts that may not be managed by RMIT systems

	will send weather data to the system, which can process and determine if the weather is deemed hazardous and send alerts.
Emergency Teams	External Emergency services, such as police, ambulance and paramedics, will get alerts and major incident reports in real-time so they can coordinate a response to the incident.

Risks

Risk	**Type**	**Description**	**Remedies**
Sensor failures	Technical	Faults in sensors or sensors being offline may cause inaccurate detection of emergencies which can result in delays in responses.	Maintain regular maintenance of the sensors and continuously monitor the status of the sensors and have backup measures in case of sensor failures.
Resistance by new users to adoption	Business	Staff, emergency response teams and students might resist signing up for new technologies because of the unfamiliarity of the subject.	Conduct proper user training programmes and collect feedback from users and make necessary modifications based on the feedback.
Miscalculations by AI	Technical	AI systems might incorrectly operate and set off false alarms which could result in failure to identify real emergencies.	Improve the training of the AI models with diverse datasets. Include human supervision when it comes to critical problems.
High Cost in implementation	Business	Building AI, IoT, and communication platforms that respond in real time	Request government funding and make partnerships with tech

		in many premises might be quite expensive and can exceed the budget.	companies. Use existing resources if possible.
Security breaches	Technical	The vulnerabilities of the system might get exploited by the attackers that can disable the emergency system and trigger false alarms.	Using strong encrypting methods to store data and enable multi-factor authentication and perform regular testing to ensure the security of the system.
System obsolescence	Business	After some time the system might be deemed outdated due to new technologies which can result in high upgrade costs. This can make it difficult to maintain the system.	Continously update AI models according to the emerging technologies, use design techniques that can easily adapt and gather new requirements and update the system based on them.

Glossary

Term	**Definition (max 30 words)**
Users	All individuals who interacts with RMIT system such as students, academic staff, administration staff, IT personnel and campus workers
Sensors	Devices that gathers and sends data to the system via internet connected devices eg. smoke detector, gas leak detector etc.
Emergency Alert	A system to notify users of an emergency situation in real-time through the use of mobile phone, SMS, or campus app
AI-driven decision support	An Artificial intelligence tool that evaluates data from sensors and gives the best response during emergency

Functional Requirement	A system feature that defines what the system should do. Focuses on the function of the system such as sending emergency alerts, integrating with IOT sensors and giving indoor navigation instructions
Non - Functional Requirement	A system property that defines how the system should perform focusing on qualities such as reliability, security, scalability, speed and maintainability etc.
Incident Report	A record of the emergency event with details of the type, time, location, and cause, providing all necessary information to Emergency services
Navigation	A digital guidance directing users to the nearest safe exit during an emergency

References

[1] Victoria (2022). *What is Emergency Alert?* | *Emergency Alert*. [online] Emergencyalert.gov.au. Available at: https://www.emergencyalert.gov.au/frequently-asked-questions/what-is-emergency-alert? [Accessed 21 Aug. 2025].

[2] Ted.com. (2025). *What Are AI-Driven Decision Support Systems?* | *TEDAI San Francisco*. [online] Available at: https://tedai-sanfrancisco.ted.com/glossary/ai-driven-decision-support-systems/? [Accessed 23 Aug. 2025].

[3] Heredia, R. (2024). *What Are IoT Sensors? Types, Uses, and Examples*. [online] Zipitwireless.com. Available at: https://www.zipitwireless.com/blog/what-are-iot-sensors-types-uses-and-examples? [Accessed 27 Aug. 2025].