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Development Status of the Advanced Vital-area Identification Software (AVIS)

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1. Introduction

VIPEX (Vital-area Identification Package EXpert) is software used for vital-area identification in nuclear facilities [1-6]. In 2015, the Nuclear Safety and Security Commission concluded that the vital areas of existing nuclear power plants in Korea did not comply with international standards and mandated their re-establishment [7]. Accordingly, vital areas were re-established across all nuclear power plants.

However, as VIPEX was developed using Visual Basic 6, it is incompatible with the latest Windows operating systems and development tools, resulting in difficulties in maintenance. Consequently, it must be redeveloped to ensure sustainability in the current development environment. Furthermore, as additional functions are needed, a new software package, AVIS (Advanced Vital-area Identification Software), is being developed during 2024–2026 as part of the project “Identification of Nuclear Power Plant Sabotage Target Sets Based on Safety Evaluation and Development of Protection Regulation Methodology” [8].

2. Methods and Results

2.1 Key Features of AVIS

AVIS employs the PSA methodology to identify target sets, prevention sets, and vital areas, which necessitates the capability to edit event trees and fault trees. Additionally, a database is necessary to store data regarding buildings, rooms, events, and the mapping between rooms and events.

Furthermore, with ongoing improvements in vital area identification methodology, AVIS must accommodate the latest 3.5 generation methodology. All input and output files must be encrypted to safeguard sensitive information. Finally, AVIS supports the automated generation of fault trees and scenarios to facilitate Force on Force (FoF) training exercises.

Table I: Key Features of AVIS

Key Feature	Description
Event Tree Editor	Ability to edit event trees
Fault Tree Editor	Ability to edit fault trees
Database	Support for OLE DB and ODBC
3D Visualization	Visualize buildings and rooms in 3D and export associated information
Vital-area Identification Methodology	Support for 1st, 2nd, 3rd, and 3.5th generation methodologies
Information Security	Encrypt all input and output files
FoF Training Scenario	Automated fault tree and training scenario generation

2.2 Comparison of VIPEX and AVIS

A comparison between the existing software VIPEX[1] and the newly developed software AVIS is summarized in Table II. A key enhancement of AVIS is the ability to edit event trees, which can be applied to support 3rd- and 3.5th-generation vital area identification methodologies.

Table II: Comparison of VIPEX and AVIS

	VIPEX	AVIS	Reason for change
Development Language	Visual Basic 6	Visual Basic .NET	Microsoft discontinues support for Visual Basic 6
Database	MS Access MDB	DBMS compatibility with OLE DB and ODBC	Version compatibility issues in Microsoft Access
Database Connectivity Library	DAO	ADO.NET	DAO support limited to MS Access MDB
3D Graphics	Direct 3D	VTK	Version compatibility issues in Direct3D
Vital-area Identification Methodology	1st and 2nd generation (3rd generation is manual)	1st, 2nd, 3rd, and 3.5th generation	
Edit Event Tree	Not available	Feature support	
FoF Training Scenario	Not available	Feature support	

2.3 Development Plan for AVIS

The three-year AVIS development plan is shown in Figure 1. In the first year, database design and a fault tree editor will be developed. In the second year, an event tree editor and vital area assessment functions will be developed. In the third year, encryption functions to ensure information security, target-set identification against cyberattacks, and physical protection will be developed.

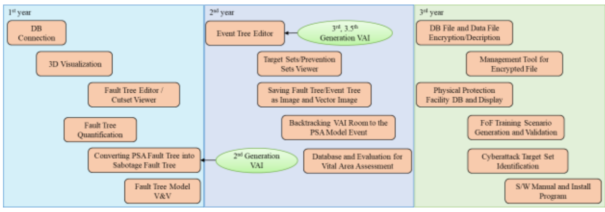


Fig. 1. Development Plan for AVIS

2.4 Modules of AVIS

Figure 2 shows the AVIS modules. The file input/output functions rely on a file encryption/decryption module. The modules that use the results of fault tree quantification require a fault tree quantification module. Fault trees can be imported from external sources or generated using the event tree and fault tree editors.

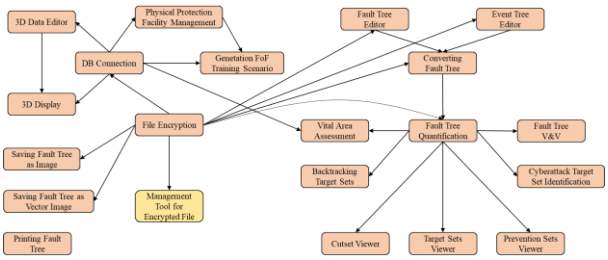
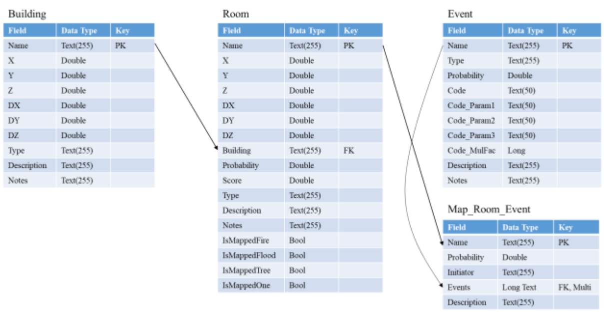


Fig. 2. AVIS module relationship diagram

2.5 AVIS Database



Building

Field	Data Type	Key
Name	Text(255)	PK
X	Double	
Y	Double	
Z	Double	
DX	Double	
DY	Double	
DZ	Double	
Type	Text(255)	
Description	Text(255)	
Notes	Text(255)	

Room

Field	Data Type	Key
Name	Text(255)	PK
X	Double	
Y	Double	
Z	Double	
DX	Double	
DY	Double	
DZ	Double	
Building	Text(255)	FK
Probability	Double	
Score	Double	
Type	Text(255)	
Description	Text(255)	
Notes	Text(255)	
IsMappedFire	Bool	
IsMappedFlood	Bool	
IsMappedTree	Bool	
IsMappedOne	Bool	

Event

Field	Data Type	Key
Name	Text(255)	PK
Type	Text(255)	
Probability	Double	
Code	Text(50)	
Code_Param1	Text(50)	
Code_Param2	Text(50)	
Code_Param3	Text(50)	
Code_MulFac	Long	
Description	Text(255)	
Notes	Text(255)	

Map_Room_Event

Field	Data Type	Key
Name	Text(255)	PK
Probability	Double	
Initiator	Text(255)	
Events	Long Text	FK, Multi
Description	Text(255)	

Fig. 3. AVIS Database

A room is contained within a building, and both the building and the room have 3D position and size information for visualization purposes. The 3D shape type can be either a cube or a cylinder. In the Map_Room_Event table, which maps room damages to equipment failures, the Name field stores the room name, while the Events field contains a list of equipment failures associated with the corresponding room damage. That is, multiple equipment failures can be mapped to a single room damage. Conversely, a single equipment failure can also be associated with multiple room damages, representing a many-to-many relationship.

3. Conclusions

VIPEX is currently incompatible with the development environment, which complicates maintenance. To address this issue, AVIS was developed using the latest Windows operating system and development tools, facilitating both maintenance and feature enhancements.

AVIS is compatible with any database supporting OLE DB or ODBC and can render 3D graphics without version-specific issues. The software also provides editing capabilities for event and fault trees, and supports the latest 3.5-generation vital-area identification methodology. In addition, all input and output files are encrypted to ensure information security.

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