Week 4: Apply Theoretical Framework

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# Apply an Appropriate Theoretical Framework

## Theoretical Foundations

There are four approaches to studying a business use-case or phenomena (see Table 1). Constructive design is one of the most common research methods for information systems and technology (Silvestrini & Sammito, 2012). These studies identify a problem, build artifacts, and communicate the implementation’s unique value (Hevner et al., 2004). In addition, many researchers follow this process to build proof-of-concept and execute case studies. Therefore, this methodology is appropriate for examining the effectiveness of the Elderly Care Smarthome Operating System (ECSOS) solution and its abilities to improve elderly care.

Table 1: Example Research Strategies for Classifying Movement in Video

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| --- | --- | --- |
| Approach | Description | Study Example |
| Quantitative | Studies the magnitude of a phenomena | Measure the resources necessary to classify movement with embedded systems |
| Qualitative | Explores a concept without a numerical basis | Exploration of reasons movement classification fails |
| Mixed-Method | Combines exploration and studying the magnitude of these issues | What preparation steps reduce the costs movement classification |
| Constructive | Produce artifacts to study a scenario | Create an algorithm for classifying movements |

## Review Literature

Constructive research practitioners gravitate toward either Design Science Research (DSR) or the Constructive Research Approach (CRA). One of the critical differences between them is that DSR relies more heavily on existing theories, versus CRA does not explicitly require a base theory (Piirainen & Gonzalez, 2013). More recently, Iivari (2020) criticizes the debate stating that constructive research must first and foremost produce high-quality artifacts. She advocates for “less theory, but better design theory (pg. 504),” especially within rapidly evolving industries like Information Technology. Zeller (2014) would agree with this position, adding success criteria that the artifacts are “challenging, elegant and useful.”

## Research Artifact Design

This research project has four core components which collectively form a proof-of-concept implementation and a mechanism to measure results. According to the literature review, these systems have the potential to output high-quality constructive research.

First, the team installs WiFi-enabled Eufycam 2C cameras to collect short recordings. These cameras use motion-sensing to trigger short Audio/Video (A/V) recordings (fifteen to sixty seconds). After the filming completes, its controller (Eufy Homebase) automatically uploads the file to Network Attached Storage (NAS). The file creation event triggers an analysis workflow that extracts and publishes metadata to message buses. Developers can author extensions using Function as a Service (FaaS) constructs that subscribe to the notifications.

Second, a machine learning algorithm will classify and annotate the video’s contents. There are several potential implementations (e.g., Open Pose versus Toyota’s approach). The performance and resource requirements between these strategies require analysis. Ideally, the AI model can run in an edge appliance versus uploading into a Public Cloud Service (PCS). However, this raises concerns that the device has sufficient computing capabilities (e.g., parallel processing dozens of cameras). If analysis occurs within the cloud, then it introduces security and privacy concerns.

Third, the ECSOS solution routes the metadata into monitoring and response extensions. These extensions include central services (e.g., identity and state management) and auditing capabilities (e.g., inputs, predictions, and recommendations). One crucial extension is the central audit logs. These tables are queryable within a NoSQL time-series database (e.g., Influx).

Fourth, users can provide feedback on model predictions through a mobile app. The feedback contains qualitative tags and centrally aggregates for offline analysis. The research team will use this database to assess the system’s accuracy and identify potential quality gaps. For instance, the responses could indicate that specific intent predictions (e.g., use fork versus use pen) are unreliable. Those issues require prioritization and potentially additional training data.

## Tenants, Controversies, and Ethical Challenges

The system’s primary purpose is to increase the patients’ quality of life by remaining within their residency longer. Therefore, this mission statement obliges the solution to detect human activity and respond reliably. Also, patients will only use a continuous video recording solution if they trust its security and privacy controls. There must be explicit and deliberate decisions regarding how information is stored or transferred.

There are four major threats to research validity internal, external, statistical conclusions, and construct validity (see Table 2). According to Parker, “it is widely accepted truism that all published research to some extent is flawed. Because the research enterprise is fraught with many pitfalls, researchers must become well-versed in recognizing, and when possible avoiding design shortcomings (Parker, 1993, p. 1).” The research must explicitly implement controls that minimize these concerns and ensure the results are reproducible. For instance, the video recordings need to include diverse subjects and automation for external quality auditing.

Table 2: Threat Sources

|  |  |
| --- | --- |
| Source | Description |
| Internal Threat | Contamination by the research team |
| External Threat | Contamination outside of the study’s controls |
| Statistical Conclusion Validity | Results are arbitrary or non-reproducible |
| Construct Validity | Controls are not enforceable or consistent |

# References

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