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Design and Scenario Based Evaluation of ATAA: An Islamic Values Informed Framework for Voluntary Sadaqah Management in Libyan Masjids

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تصميم وتقييم إطار عطاء المستنير بالقيم الإسلامية لإدارة الصدقات التطوعية في المساجد الليبية باستخدام السيناريوهات

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Abstract:
Digital information systems can support the organization and reporting of voluntary Sadaqah campaigns associated with Masjids. However, effective management requires more than an online contribution form; it depends on clearly defined contribution states, duplicate record prevention, consistent handling of campaign targets and recurring schedules, and reconciliation of reported totals with underlying records. This study proposes ATAA, an Islamic value informed framework for managing voluntary Sadaqah campaigns associated with Masjids in Libya. Guided by a Design Science Research approach, the study evaluates an independent JavaScript/Node.js reference model using synthetic data. The framework's design rationale draws on ethical concepts such as trustworthiness, accountability, and truthful reporting, which are mapped to selected operational requirements without implying religious certification. Ten predefined functional scenarios address individual and collective contributions, duplicate identifiers, target attainment, over target contributions, recurring period duplication, closed campaigns, report reconciliation, excluded contribution statuses, and invalid amounts. All ten scenarios passed their predefined assertions. A separate in memory aggregation benchmark used synthetic datasets of 1,000, 10,000, and 100,000 records. Median per pass execution times were 0.002 ms, 0.031 ms, and 0.354 ms, respectively, while the corresponding 95th percentile values were 0.003 ms, 0.043 ms, and 0.461 ms. These measurements characterize only the aggregation routine under the recorded runtime environment; they do not represent the performance of a deployed application, database, payment gateway, or concurrent workload. The study contributes a bounded framework specification, explicit operational invariants, and an initial computational evaluation. It does not establish improved donor trust, institutional transparency, religious compliance, production readiness, or end to end scalability.

Keywords: Sadaqah management; Islamic values informed design; Masjid information systems; Libya; Design Science Research; financial accountability; synthetic data; functional testing.

الملخص:
تساهم نظم المعلومات الرقمية في تنظيم حملات الصدقة التطوعية المرتبطة بالمساجد وإعداد تقاريرها من خلال ضبط سجلات المساهمات ومنع تكرارها ومتابعة الأهداف المالية وتنظيم المساهمات الدورية وضمان إمكانية مطابقة الإجماليات الواردة في التقارير مع السجلات الأصلية.
تقترح هذه الدراسة إطار عطاء لإدارة حملات الصدقة التطوعية في المساجد الليبية، مستنير بالقيم الإسلامية ذات الصلة بالأمانة والمسؤولية وصدق التقارير وتقيمه باستخدام نموذج مرجعي وبيانات اصطناعية. شمل التقييم عشرة سيناريوهات

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وظيفية محددة مسبقا اجتازت جميعها الاختبارات المقررة. كما تم اختبار معياري لقياس زمن تجميع البيانات باستخدام مجموعات اصطناعية تضم ألف سجل وعشرة آلاف سجل ومائة ألف سجل وأظهرت النتائج زيادة زمن التنفيذ مع زيادة حجم البيانات.
وتقتصر النتائج على التحقق من الوظائف المختبرة وقياس أداء عملية تجميع البيانات ضمن بيئة التشغيل المستخدمة ولا تثبت جاهزية الإطار للتطبيق الفعلي أو زيادة ثقة المتبرعين أو تعزيز الشفافية المؤسسية أو تحقيق الامتثال الشرعي. وتتمثل إسهامات الدراسة في تقديم إطار مقترح ذي قواعد تشغيلية واضحة وربط بعض متطلبات تصميمه بمبادئ أخلاقية مستمدة من القيم الإسلامية وإجراء تقييم حاسوبي أولي يمهد لمزيد من التطوير والتحقق من ملاءمته للاستخدام الفعلي.

الكلمات المفتاحية: الصدقات التطوعية، القيم الإسلامية في التصميم، نظم المعلومات للمساجد، ليبيا، البحث في علوم التصميم، المساءلة المالية، البيانات الاصطناعية، الاختبارات الوظيفية.

1. Introduction

Masjids serve religious, educational, social, and charitable functions within their communities. Their activities may involve voluntary contributions for maintenance, educational initiatives, community support, and other charitable campaigns. Managing these activities requires reliable contribution records, consistent monitoring of campaign targets, coordination among responsible administrators, and the preparation of accurate financial summaries. In this context, digital information systems can provide structured mechanisms for recording contributions and supporting the review of campaign related financial information.

Previous research has examined financial accountability and internal controls in Masjid fund management, web-based Masjid management systems, and digital platforms for financial reporting. These studies establish that applying information technology to Masjid administration is an existing research area rather than a new concept in itself [1],[3]. However, the design of a voluntary Sadaqah management framework also requires explicit rules governing how contribution records are created, processed, aggregated, and reported.

A digital campaign interface may display a total contribution amount, but the reliability of that figure depends on the rules applied to the underlying records. These rules include determining which contribution statuses count toward the accepted total, preventing duplicate submissions, identifying recurring contribution periods, handling campaign targets, and reconciling reported figures with their source records. Without clearly defined operational rules, displayed totals may be difficult to verify consistently.

This study proposes ATAA, an Islamic value informed framework for managing voluntary Sadaqah campaigns associated with Masjids in Libya. The framework translates selected ethical concepts, including amanah (trustworthiness and responsible stewardship), mas'uliyyah (responsibility and accountability), and sidq (truthfulness), into a rationale for specific information system requirements. These concepts inform the proposed treatment of contribution records, the consistency of financial summaries, and the reconciliation of reported totals. This design perspective does not imply religious certification or establish that software controls alone guarantee ethical conduct or institutional accountability.

The study evaluates an independent JavaScript/Node.js reference model using synthetic records rather than a deployed mobile or web application. No real payments or financial records from actual Masjids are used. Accordingly, the findings provide evidence about the reference model's behavior under predefined computational scenarios, not about its operational effectiveness in real institutions. The Libyan setting defines the intended context of the proposed framework; the study does not claim that its requirements have been validated with Libyan Masjid administrators or contributors.

ATAA is specifically limited to the management and documentation of voluntary Sadaqah. Zakat calculation, collection, eligibility assessment, and distribution are outside the scope of the framework. The proposed system does not issue religious rulings or determine religious obligations. Its purpose is to organize and document voluntary contributions through explicit and testable information system rules.

The study makes three contributions:

1. It proposes an Islamic value informed framework for managing individual, collective, and recurring voluntary Sadaqah activities associated with Masjid campaigns.
2. It specifies operational invariants governing contribution identifiers, amounts, statuses, recurring periods, campaign closure, target calculations, and report reconciliation, linking selected requirements to the framework's ethical design rationale.
3. It evaluates an independent reference model through ten predefined functional scenarios and a bounded in-memory aggregation benchmark using synthetic datasets.

1.1 Research Questions

The study addresses the following research questions:

RQ1. How can selected Islamic ethical concepts inform the design requirements of a framework for managing individual, collective, and recurring voluntary Sadaqah campaigns associated with Masjids in Libya?

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RQ2. To what extent does an independent reference model conform to predefined functional and reconciliation rules under synthetic test scenarios?
RQ3. How does the measured execution time of the reference model's in-memory aggregation routine vary across synthetic datasets of different sizes, and what conclusions can reasonably be drawn from these measurements?

1.2 Scope and Boundaries

The study evaluates a proposed framework and an independent reference model. It does not evaluate a production application, real payment integration, persistent database operations, security controls, concurrent transactions, user experience, institutional adoption, or actual financial outcomes.
In this study, traceability refers to the ability to relate reported totals to identifiable contribution records and explicit record states. It is treated as a technical design property rather than a direct measure of institutional transparency. Institutional transparency also depends on record completeness, administrative conduct, financial authorization procedures, and the accessibility and comprehensibility of published information.
Similarly, the Islamic values informed perspective provides an ethical rationale for selected design requirements; it does not constitute a religious ruling or a claim of Shariah compliance. The computational evaluation tests specified software behaviors, while the ethical and contextual adequacy of the proposed requirements remains to be examined through future engagement with relevant stakeholders in Libya.

2. Literature Review and Related Work

The literature relevant to ATAA spans four connected areas: financial accountability and internal controls in Masjid management, digital information systems for Masjid administration, digital donation platforms and financial disclosure, and Islamic values informed approaches to information system design. These areas provide complementary perspectives on the organizational, technical, and ethical considerations relevant to voluntary Sadaqah management. However, evidence from one area should not be treated as direct evidence for claims concerning another.

2.1 Financial Accountability and Internal Controls in Masjid Management

Financial accountability is an important concern for organizations that receive and manage community contributions. In the Masjid context, accountability extends beyond recording incoming funds to include expenditure documentation, clearly assigned responsibilities, reliable recordkeeping, and procedures for reviewing financial activities.
examined accountability and internal control issues in Masjid fund management. Their study highlights the importance of control practices relating to the receipt and disbursement of funds [1]. This work provides a basis for distinguishing the technical act of recording financial information from the broader organizational procedures required to support accountability.
investigated financial reporting practices and accountability in a Malaysian Masjid context [2]. Their study discusses challenges associated with inconsistent financial recording, delayed documentation, and limited public disclosure. Because their research concerns a specific institutional setting, its findings cannot automatically be generalized to Masjids in Libya. Nevertheless, it illustrates why the availability of digital tools does not, by itself, guarantee transparent or accountable financial management.
These studies motivate a distinction between computational integrity and institutional accountability. Computational integrity concerns whether records, statuses, and calculated totals conform to defined rules. Institutional accountability additionally depends on governance arrangements, authorization, review procedures, and appropriate disclosure. The current ATAA evaluation addresses selected computational properties but does not directly assess institutional accountability.

2.2 Digital Information Systems for Masjid Finance

Digital information systems can support the recording, organization, and presentation of financial information in Masjid administration [3]. describe a web-based portal for Masjid financial management, while examine a web-based Masjid management information system through a case study of Darul Amal Masjid [4]. Such work demonstrates that the use of digital systems in Masjid administration and financial reporting is an established area of development.
Accordingly, ATAA should not be presented as the first digital Masjid management system. Its proposed contribution is narrower: the specification of voluntary Sadaqah campaign workflows, the definition of explicit operational invariants, and the computational evaluation of an independent reference model.
The existence of a system feature, such as contribution recording or financial reporting, does not necessarily demonstrate that the underlying rules have been evaluated through predefined functional tests. Conversely, successful functional tests do not establish that a system is usable, secure, or suitable for institutional deployment. These distinctions inform the bounded evaluation adopted in this study.

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2.3 Digital Donation Platforms, Financial Disclosure, and Donor Credibility

Research on online charitable crowdfunding provides a complementary perspective on donation related information systems and donor behavior. investigated online charitable crowdfunding in Indonesia using responses from 405 Muslim participants. Their study examined factors associated with donation intention, including perceived credibility and empathy [5]. It offers relevant background on donor perceptions in digital charitable giving, but it does not evaluate ATAA or establish that specific reporting mechanisms will produce equivalent effects in Libya.

examined financial management practices in six Islamic donation based crowdfunding platforms in Malaysia [6]. Their work addresses governance and financial management considerations in digital donation environments. However, the organizational practices of crowdfunding platforms differ from the operational requirements of a Masjid specific voluntary Sadaqah framework. The findings therefore provide contextual evidence rather than direct validation of ATAA's design.

The broader implication is that financial reporting features should not be assumed to produce trust or transparency automatically. The reliability of reported information depends on the quality and completeness of underlying records, the treatment of rejected and cancelled contributions, and the governance procedures surrounding financial activities. ATAA consequently treats reports as derived summaries of contribution records rather than as independent sources of financial truth.

Whether such a design improves donor confidence remains an empirical question. The present study does not measure donor perceptions or institutional transparency; it evaluates selected computational rules that may support the traceability of reported totals.

2.4 Islamic Values Informed Design of Information Systems

An Islamic value informed design perspective provides an ethical rationale for selecting and interpreting certain information system requirements. Rather than treating ethical principles as decorative statements, this perspective considers how values can inform system functions, data handling rules, and accountability mechanisms.

explored the design of accountability from Islamic perspectives using Value Sensitive Design [7]. Their work provides a direct conceptual connection between Islamic ethical considerations and information system design. It supports the proposition that ethical values can inform design decisions, while also indicating the need to translate broad values into specific system strategies.

Research on Islamic ethics and technology provides additional conceptual context.) proposed an Islamic virtue based ethical framework for artificial intelligence, drawing on Islamic ethical concepts and objectives [8]. examined Islamic ethical traditions in relation to contemporary technology ethics and argued for a pluralist approach to ethical benchmarking [9]. These studies focus on artificial intelligence rather than Masjid financial systems; therefore, they are used here only to support the broader methodological rationale for considering Islamic ethical perspectives in technology design.

In ATAA, selected concepts are used to motivate specific requirements. Amanah, understood as trustworthiness and responsible stewardship, informs the careful handling of contribution records. Mas'uliyyah, referring to responsibility and accountability, motivates the traceability of reported totals and the explicit treatment of contribution statuses. Sidq, associated with truthfulness, informs the requirement that reported summaries accurately reflect the underlying records according to the defined aggregation rules.

These mappings are proposed design interpretations rather than claims that the selected technical controls exhaust the meaning of the relevant Islamic concepts. Rejecting duplicate identifiers, excluding cancelled records from accepted totals, and reconciling reports are testable software behaviors. They do not, on their own, establish ethical conduct, religious compliance, or institutional accountability. Those broader outcomes depend on human practices, governance arrangements, and contextual considerations that are outside the present computational evaluation.

The ethical perspective adopted in this study should therefore be understood as a design rationale. The study does not provide a religious ruling, claim Shariah certification, or empirically establish that the proposed requirements reflect the views of Libyan Masjid administrators or contributors.

2.5 Design Science Research and Computational Evaluation

Design Science Research (DSR) provides a methodological orientation for constructing and evaluating artifacts intended to address identified problems. emphasize the relationship between an information system artifact, the problem it addresses, and the evidence used to evaluate it [10]. describe a structured research methodology that includes problem identification, definition of objectives, design and development, demonstration, evaluation, and communication [11].

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The present study follows this general orientation by proposing a framework and evaluating an executable reference model against selected operational requirements. The evaluation combines predefined functional scenarios with an in-memory aggregation benchmark using synthetic data.

Functional testing provides evidence about whether a model produces expected outputs for the tested inputs and conditions. A benchmark provides measurements of a specified computational routine under a documented runtime environment. Neither form of evidence alone establishes usability, security, institutional effectiveness, ethical adequacy, or production scalability.

The study's evaluation is therefore deliberately limited. It examines selected functional and computational properties of the reference model rather than the performance of a deployed application or its effects on actual Masjid communities.

2.6 Synthesis and Research Gap

The reviewed literature establishes that Masjid financial accountability, digital administration, donation platform governance, and Islamic values informed technology design have each received scholarly attention. Existing work on Masjid fund management and digital reporting demonstrates the relevance of financial controls and information systems. Research on digital charitable giving highlights the importance of disclosure and perceived credibility, while studies of Islamic ethics and technology provide a conceptual basis for incorporating ethical considerations into design decisions.

However, these research streams address different problems and operate at different levels of analysis. Studies of Masjid financial management primarily inform organizational accountability and reporting. Digital donation platform research provides context for financial disclosure and donor perceptions. Islamic technology ethics research offers conceptual guidance but does not directly validate requirements for voluntary Sadaqah management in Libyan Masjids.

Within the scope of the literature reviewed for this study, the specific research opportunity is to combine:

1. A proposed framework for managing individual, collective, and recurring voluntary Sadaqah campaigns associated with Masjids in Libya.
2. Explicit operational invariants for contribution identifiers, amounts, statuses, recurring periods, campaign closure, target calculations, and report reconciliation.
3. An Islamic value informed design rationale that links selected ethical concepts to specified system requirements.
4. A bounded computational evaluation of an independent reference model using predefined functional scenarios and an in-memory aggregation benchmark with synthetic data.

The contribution claimed here is this specific combination of design specification, ethical rationale, and bounded computational evaluation not the invention of digital Masjid administration or a demonstration of improved donor trust. The gap remains provisional because this study uses a focused narrative review rather than an exhaustive systematic review. A broader search across Englis and Arabic language academic databases, regional repositories, conference proceedings, and existing implementations would be needed to determine how comprehensively the relevant prior work has been covered.

3. Methods

3.1 Research Design

This study adopts a Design Science Research (DSR) orientation to develop and computationally evaluate ATAA, a proposed framework for managing voluntary Sadaqah campaigns associated with Masjids. The unit of analysis is the behavior of an executable reference model under specified inputs, rather than a Masjid, donor, or real financial transaction.

The study comprises three methodological components: (1) specification of the proposed framework, including its conceptual entities, operational rules, and intended workflows; (2) scenario based functional testing using ten predefined scenarios and corresponding expected outcomes; and (3) a synthetic data benchmark of an in-memory aggregation routine using datasets of different sizes.

No human participants were recruited, and no interviews, surveys, direct observations, or real financial records were used.

For each functional scenario, the initial model state and input were defined, the reference model was executed, and the resulting state and calculated totals were compared against predefined assertions. The outcome was then recorded as a pass or fail. The benchmark was conducted separately to examine the aggregation routine under increasing synthetic data volumes.

Because the framework, reference model, and test scenarios were developed within the same research workflow, the evaluation is susceptible to implementation bias. Accordingly, the findings should be interpreted as evidence of selected functional properties and benchmark behavior, rather than independent validation of the complete framework. Independent test design and broader evaluation remain necessary in future work.

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3.2 Islamic Values Informed Design Principles

ATAA adopts an Islamic value informed design perspective in which ethical principles provide a conceptual basis for selected information system requirements. In the context of voluntary Sadaqah management, the framework considers amanah (trustworthiness and responsible stewardship), mas'uliyyah (responsibility and accountability), and sidq (truthfulness) as relevant ethical concepts. These principles are used as design considerations rather than as claims of religious certification or legal compliance.

The translation of these concepts into system requirements is intentionally limited to properties that can be specified and examined computationally. The principle of amanah motivates careful handling of contribution records and the prevention of duplicate identifiers. Mas'uliyyah informs the need for identifiable records, status aware reporting, and reconciliation between reported totals and underlying data. Sidq supports the accurate presentation of contribution totals and the explicit exclusion of rejected or cancelled records from accepted contribution summaries. These mappings represent the proposed design rationale; they do not imply that software controls alone establish ethical conduct or institutional accountability.

The functional evaluation examines selected technical properties associated with these requirements, including duplicate record rejection, contribution status handling, and report reconciliation. However, the study does not measure users' ethical perceptions, assess religious compliance, or establish that ATAA increases donor trust. The relationship between Islamic ethical principles and the proposed system requirements should therefore be understood as a design rationale that requires further assessment with relevant stakeholders in the intended Libyan context.

Table 1. Mapping of Islamic Ethical Values to Technical Requirements and Evaluation Status

Islamic Value	Design Interpretation	Technical Requirement	Evaluation Status
Amanah	Responsible stewardship of contributions	Contribution identification, status-aware aggregation, and report reconciliation	Technical Requirements Tested
Mas'uliyyah	Responsibility and accountability	Traceable contribution records and consistent campaign reporting	Technical Requirements Tested
Sidq	Truthfulness and accuracy	Accurate aggregation and consistent reporting of accepted contributions	Technical Requirements Tested

The evaluation status "Technical Requirements Tested" indicates that the technical requirements derived from the Islamic ethical values were examined using the reference model. It does not imply that the ethical values themselves or religious and Shariah compliance were empirically tested or established.

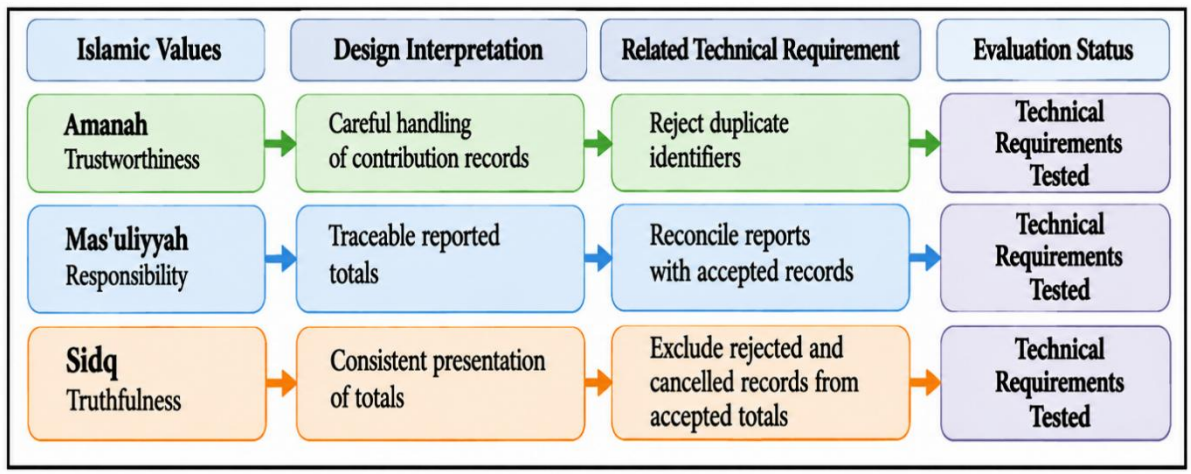


Figure 1. Mapping Islamic values to technical requirements

3.3 Proposed ATAA framework

ATAA is a proposed framework for organizing voluntary Sadaqah campaigns associated with Masjids. Its conceptual model contains six entities:

1. Masjid: identifies the institution associated with a campaign.
2. Campaign: records campaign information, its target amount, and its status.
3. Contribution: records an individual contribution event, including its identifier, amount, and status.

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4. Recurring Schedule: represents an intended recurring contribution period associated with a contributor and campaign.
5. Audit Event: represents a record of relevant changes or administrative actions in a future implementation.
6. Report: presents derived totals and campaign summaries calculated from the underlying records.

The inclusion of an Audit Event entity in the conceptual framework should not be interpreted as evidence that a production grade audit log has been implemented or security tested. Its purpose is to identify a design requirement for subsequent development.

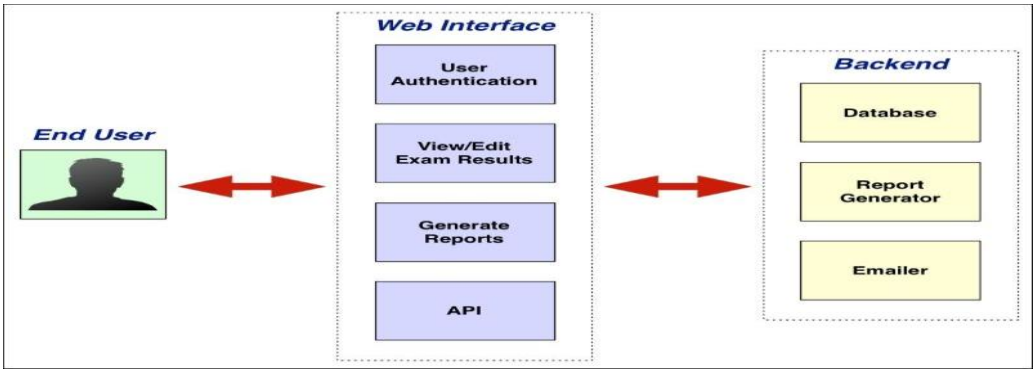


Figure 2. Conceptual architecture of the ATAA framework

3.4 Contribution states and record integrity

A central design principle is to distinguish a submitted contribution record from an accepted record and from a verified financial transfer. These states are not interchangeable.

A record can be accepted by the reference model for the purpose of its internal logic without proving that a bank transfer or payment provider transaction has settled. Since the model does not integrate with a payment gateway, it cannot independently verify real world transfer completion.

Contribution amounts are represented as positive safe integers in minor currency units. This avoids common floating point representation problems in financial arithmetic. The currency and its minor unit convention would need to be configured and validated for a real deployment.

Only records in the accepted state contribute to the accepted campaign total. Rejected and cancelled records are excluded from that total but should remain identifiable as distinct records rather than being silently treated as accepted contributions.

3.5 Operational Invariants

The reference model evaluates the following operational invariants:

I1. Contribution identifier uniqueness. A contribution identifier must not be accepted more than once within the same campaign.

I2. Positive contribution amount. Each contribution amount must be a positive safe integer expressed in minor currency units.

I3. Status aware aggregation. Only contributions with an accepted status are included in the accepted total.

I4. Campaign target calculation. The remaining target is calculated as:

$$[\text{Remaining Target}=\max(0,\text{Target}\text{Accepted Total})]$$

The campaign target is considered reached when:

$$[\text{Accepted Total}\geq\text{Target}]$$

I5. Recurring period uniqueness. A user–period key must not be duplicated within the same campaign.

I6. Campaign status. A new contribution must be rejected if the campaign is not active.

I7. Report reconciliation. The reported accepted total must match the total recalculated from contribution records with an accepted status.

These invariants represent a selected subset of the reference model's required behavior. They do not establish comprehensive coverage of all financial, operational, legal, or security requirements.

3.6 Functional test scenarios

Ten functional scenarios were specified. They cover individual and collective contributions, duplicate identifiers, campaign target calculations, over target arithmetic, duplicate recurring periods, closed campaigns, report reconciliation, excluded statuses, and invalid contribution amounts.

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A scenario was counted as passing when the observed outcome matched its predefined expected assertion. The pass rate is calculated as:

\[\text{Pass Rate}= \frac{\text{Number of Passed Tests}} {\text{Total Number of Tests}}\times100 \]

The resulting pass rate describes only the ten selected tests. It is not a measure of complete correctness, overall software quality, or production readiness.

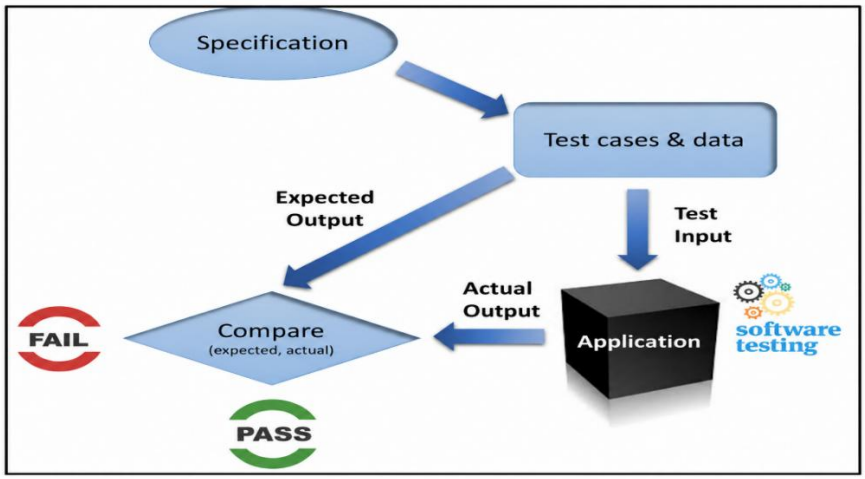


Figure 3. Scenario based evaluation workflow

3.7 Synthetic data benchmark

A separate benchmark evaluated the in-memory aggregation routine using synthetic datasets of 1,000, 10,000, and 100,000 records. The recorded environment was Node.js v22.16.0 on Linux x64.

For each dataset size, eight warmup runs were conducted before 30 measured batches. Each measured batch was configured to scan approximately 20 million records in total. The reported timing summaries include the mean, standard deviation, median, 95th percentile (P95), and minimum maximum range of the measured per pass times.

The benchmark concerns the aggregation routine only. It does not include database operations, network latency, payment verification, authentication, authorization, logging, interface rendering, or concurrent requests. The very short times particularly for the smallest dataset are also sensitive to timer resolution and runtime optimization.

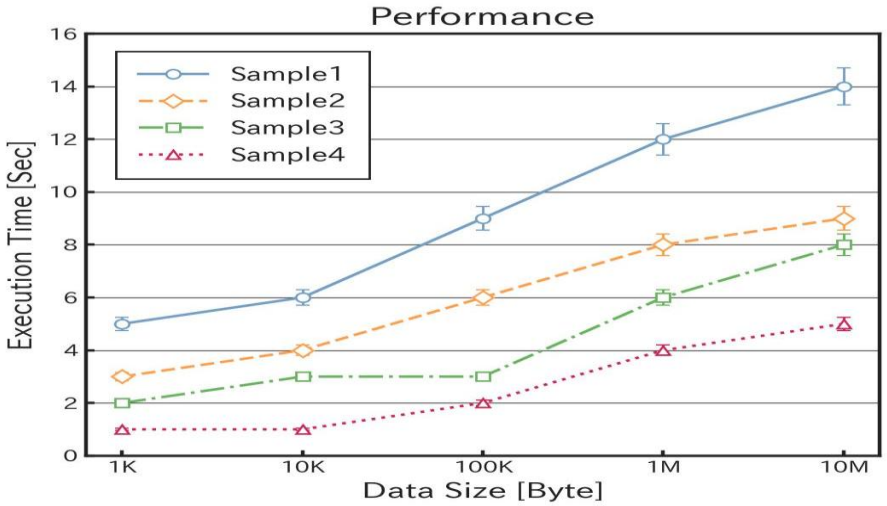


Figure 4. Aggregation time across synthetic dataset sizes

3.8 Methodological limitations

The same research workflow defined the framework, the reference model, and the test scenarios. This can introduce bias if the tests reflect only the cases the implementation was designed to pass. Future evaluation should include independent test design, boundary value analysis, property-based testing, state transition testing, fault injection, and concurrent request tests.

The synthetic records support repeatability, but they do not reproduce the distribution or behavior of real contributors. Likewise, the use of a single runtime environment limits the generalizability of the timing results.

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4. Results

4.1 Functional Verification

The reference model passed all ten predefined functional scenarios, yielding a test pass rate of 100%. This result indicates conformance to the expected outcomes specified for the selected scenarios; it does not establish complete correctness, the absence of defects, or readiness for production deployment.

The scenarios covered contribution aggregation, identifier uniqueness, campaign target calculations, recurring period uniqueness, campaign status enforcement, report reconciliation, contribution status handling, and amount validation. Table 2 summarizes the test scenarios and their outcomes.

Table 2. Results of the Predefined Functional Scenarios

Test ID	Scenario	Outcome
F01	An accepted individual contribution updates the campaign total	Pass
F02	Multiple contributions are aggregated correctly	Pass
F03	A duplicate contribution identifier is rejected	Pass
F04	The campaign target is identified as reached when the total meets the target	Pass
F05	Over target contributions remain arithmetically consistent	Pass
F06	A duplicate recurring schedule for the same user and period is rejected	Pass
F07	A contribution to a closed campaign is rejected	Pass
F08	The reported total reconciles with accepted contribution records	Pass
F09	Rejected and cancelled contributions are excluded from the accepted total	Pass
F10	A nonpositive or otherwise invalid contribution amount is rejected	Pass

The resulting pass rate was:

[\text{Pass Rate}=\frac{10}{10}\times100=100%]

The duplicate identifier scenario checked whether a second record with the same identifier was rejected without incorrectly increasing the accepted total. The status related scenario checked whether rejected and cancelled records were excluded from the accepted total. The recurring schedule scenario examined the uniqueness of the user period key, while the closed campaign scenario checked whether new contributions were rejected when a campaign was closed.

The reconciliation scenario compared the reported accepted total with a recomputation over accepted contribution records. The strength of this result depends on the independence of the recomputation procedure: an independently implemented calculation provides stronger evidence than a comparison that reuses the same aggregation logic.

Overall, the results provide evidence that the reference model conformed to the specified assertions under the tested conditions. They do not establish the correctness of a future database backed implementation or its behavior under concurrent requests and distributed transactions.

4.2 In-Memory Aggregation Benchmark

The benchmark measured the execution time of one aggregation pass over synthetic datasets containing 1,000, 10,000, and 100,000 records. Table 3 summarizes the recorded timing statistics for 30 measured batches at each dataset size.

Table 3. In-Memory Aggregation Timing by Synthetic Dataset Size

Records	Measured batches	Mean (ms)	SD (ms)	Median (ms)	P95 (ms)	Min–max (ms)
1,000	30	0.003	0.000	0.002	0.003	0.002–0.003
10,000	30	0.032	0.005	0.031	0.043	0.026–0.049
100,000	30	0.367	0.043	0.354	0.461	0.315–0.465

These measurements describe the in-memory aggregation routine only; they are not end to end response times for an ATAA application.

The median execution time increased from 0.002 ms for 1,000 records to 0.031 ms for 10,000 records and 0.354 ms for 100,000 records. The corresponding P95 values were 0.003 ms, 0.043 ms, and 0.461 ms, respectively.

These results show an increase in measured aggregation time with dataset size under the recorded benchmark conditions. However, measurements at only three dataset sizes are insufficient to establish a general scaling relationship or predict production capacity. The short execution times, particularly for the smallest dataset, may also be sensitive to timer resolution, runtime optimization, and measurement methodology.

Accordingly, the benchmark provides an initial performance baseline for the in-memory aggregation routine rather than evidence of endtoend application performance or production scalability. The results should not be used to estimate the maximum number of users or transactions that ATAA could support.

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4.3 Evidence in Relation to the Research Questions

Table 4. Research Questions and Evidence Supported Conclusions

Research question	Evidence	Warranted conclusion
RQ1: How can a framework for voluntary Sadaqah management in Libyan Masjids be specified?	Framework entities, workflows, and operational invariants	A proposed design specification has been produced; its suitability for actual Libyan Masjid practices remains to be validated.
RQ2: Does the reference model conform to predefined rules?	Ten predefined functional scenarios, all passing	The model conforms to the expected outcomes covered by the selected test suite.
RQ3: How does aggregation time vary with dataset size?	Timing summaries for datasets of 1,000, 10,000, and 100,000 records	Measured in-memory aggregation time increased with dataset size under the recorded conditions; production scalability remains unverified.

Taken together, the results provide a limited computational evaluation of the proposed framework's reference model. They do not establish usability, security, end to end financial performance, changes in donation behavior, or improvements in Masjid governance.

5. Discussion

5.1 Interpretation in Relation to Prior Work

Prior research has addressed financial accountability, internal controls, and digital reporting in Masjid related contexts. examined accountability and internal controls in Masjid fund management [1], while studied financial reporting practices and accountability in a Malaysian Masjid context [2]. Digital system proposals, further demonstrate that web-based Masjid management and financial information systems have already been explored [3],[4].

Against this background, ATAA is not presented as the first digital system for Masjid administration or financial transparency. Rather, its contribution lies in specifying selected voluntary Sadaqah workflows as explicit operational requirements and examining their behavior through a computational reference model, predefined functional scenarios, and synthetic data. This contribution is limited to the proposed design and its tested implementation.

Research on digital charitable giving also highlights the relevance of credibility and financial disclosure. investigated factors associated with donation intention in an Indonesian online charitable crowdfunding context [5], while examined financial management and governance practices across Islamic donation based crowdfunding platforms in Malaysia [6]. These studies provide a broader context for considering financial controls and disclosure in digital charitable giving, but they do not validate the ATAA model or establish that similar effects would occur in Libya.

Accordingly, ATAA represents an early computational contribution to a broader organizational and technological problem. Its suitability for Libyan Masjid practices and its potential institutional effects remain to be evaluated empirically.

5.2 What the functional results establish

The ten passing scenarios show that the reference model produced the expected outcomes for the cases that were tested. This is useful because the framework's rules are stated in operational terms rather than left as general aspirations.

However, a limited functional test suite cannot establish complete correctness. For example, rejecting a duplicate identifier in an in-memory data structure does not guarantee that a future distributed application will prevent duplicate records under simultaneous requests. A production implementation would need suitable database constraints, transaction handling, and error recovery mechanisms.

Similarly, reconciliation between stored records and a recomputed total establishes arithmetic consistency within the tested model. It does not establish that the records correspond to authentic financial transfers. External payment confirmation and appropriate reconciliation with payment provider or bank records would require separate design and evaluation.

5.3 Interpretation of the Aggregation Benchmark

The benchmark provides an initial indication of how the in-memory aggregation routine behaves as the number of synthetic records increases. However, these measurements characterize only the isolated routine under the recorded execution conditions.

In a deployed application, database operations, network communication, access control, logging, and concurrent requests may contribute substantially to overall latency. Consequently, the observed timings cannot establish the scalability or transaction processing capacity of a complete ATAA implementation.

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Future evaluation should measure realistic request paths using persistent storage and concurrent workloads, reporting latency distributions, throughput, resource utilization, and error rates under a documented load profile.

5.4 Contextual Relevance to Libya

ATAA is proposed for a Libyan setting, and its terminology and workflows are intended to be contextually appropriate. Nevertheless, the study did not interview Masjid administrators or contributors in Libya. It therefore cannot establish that the proposed workflows reflect current practices across Libyan institutions.

Before implementation, requirements elicitation should examine how participating Masjids define and approve campaigns, record contributions, document expenses, authorize administrative actions, and determine which information may be disclosed publicly. It should also establish which payment services and identity mechanisms are available and appropriate for the intended deployment.

The framework is intended to support responsible documentation without assuming that all Masjids have the same administrative capacity or reporting procedures. Local validation is therefore an essential next step, as the current computational evaluation does not establish ATAA's suitability for actual Libyan Masjid practices. Furthermore, using Islamic ethical concepts as design principles does not constitute religious certification or establish Shariah compliance. Any such assessment would require separate evaluation involving relevant stakeholders and qualified religious authorities.

5.5 Transparency and accountability

The proposed framework may support reviewability by linking reports to identifiable contribution records and explicitly distinguishing accepted, rejected, and cancelled states. Such features can make the logic behind a displayed total easier to inspect.

Nevertheless, transparency is not solely a software property. It depends on whether records are complete, whether administrators follow appropriate procedures, whether expenditures are documented, and whether reports are independently reviewable and understandable to stakeholders. The present study does not measure any of these institutional outcomes.

For this reason, the study treats traceability and reconciliation as technical mechanisms that may support accountability, not as evidence that ATAA increases donor trust or improves institutional transparency. These potential effects require a separate empirical study.

5.6 Scope of Sadaqah and separation from Zakat

ATAA is restricted to voluntary Sadaqah management. Zakat calculation, collection, eligibility assessment, and distribution are outside the scope of the framework and the evaluation.

This boundary is important both functionally and methodologically. The current tests concern only the synthetic voluntary Sadaqah scenarios encoded in the reference model. They should not be interpreted as validating a system for Zakat administration or for other forms of Islamic social finance. Any extension to a different domain would require its own requirements analysis, governance design, and appropriate evaluation.

5.7 Limitations and Threats to Validity

Several limitations constrain the interpretation of the findings.

- **Construct validity**. Identifiers, record states, and recomputed totals represent selected computational properties; they do not directly measure institutional transparency, donor confidence, or accountability.
- **Internal validity**. The ten predefined scenarios may not cover all relevant boundary conditions or implementation defects. Independent test design and broader testing are needed.
- **External validity.** No Masjid administrators, contributors, or financial officers participated. The framework's suitability for Libyan Masjid practices therefore remains unvalidated.
- **Measurement validity**. The benchmark covers a single in-memory routine in one recorded runtime environment. Its short execution times are sensitive to runtime behavior and measurement granularity and cannot establish end to end performance.
- **Implementation validity**. Persistent storage, real payment verification, concurrent writes, authentication, authorization, privacy, and security were not evaluated.
- **Institutional and ethical validity**. The study does not establish legal compliance, usability, accessibility, institutional adoption, or religious approval. No religious certification is claimed.

These limitations define the scope of the evidence: the study evaluates selected computational properties of a proposed framework, rather than its operational effectiveness or institutional impact.

6. Conclusion

This study presented ATAA, a proposed framework for managing voluntary Sadaqah campaigns associated with Masjids in Libya. The framework specifies conceptual entities and selected operational invariants addressing contribution identifiers, amounts, statuses, recurring periods, campaign closure, target calculations, and report reconciliation.

The JavaScript/Node.js reference model passed all ten predefined functional scenarios. A separate in-memory aggregation benchmark reported median per pass times of 0.002 ms, 0.031 ms, and 0.354 ms for synthetic

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datasets containing 1,000, 10,000, and 100,000 records, respectively. These findings characterize the tested model and aggregation routine under the recorded conditions; they do not establish production readiness, end to end scalability, improved financial transparency, or increased donor trust.

The study contributes a bounded design specification and an initial computational evaluation. Future work should validate the requirements with relevant Libyan stakeholders, implement persistent data storage and appropriate security controls, evaluate payment service integration where applicable, and conduct broader functional and performance testing. Subsequent empirical research could examine usability, institutional accountability, and donor perceptions.

Finally, the Islamic values informed perspective provides an ethical rationale for selected technical requirements, but the current evaluation does not establish their contextual or religious adequacy. These aspects require separate assessment involving relevant stakeholders and, where appropriate, qualified religious authorities.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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