

Prepared by

Milind Kurma, Punit Malpani , Luke kim, Sharmisha Parvathaneni

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Table of Contents

| | | |
|----|---|----|
| | List of Figures | 7 |
| | | |
| | List of Tables | 8 |
| | | |
| I | Project Description | 4 |
| | | |
| 1 | Project Overview | 4 |
| | | |
| 2 | The Purpose of the Project | 4 |
| | | |
| 2a | The User Business or Background of the Project Effort | 4 |
| | | |
| 2b | Goals of the Project | 4 |
| 2c | Measurement | 9 |
| | | |
| 3 | The Scope of the Work | 9 |
| | | |
| 3a | The Current Situation | 10 |
| 3b | The Context of the Work | 10 |
| 3c | Work Partitioning | 11 |
| 3d | Competing Products | 12 |
| 4 | The Scope of the Product | 12 |
| | | |
| 4a | Scenario Diagram(s) | 12 |
| 4b | Product Scenario List | 12 |
| 4c | Individual Product Scenarios | 12 |
| 5 | Stakeholders | 12 |
| | | |
| 5a | The Client | 12 |
| 5b | The Customer | 13 |
| 5c | Hands-On Users of the Product | 13 |
| 5d | Maintenance Users and Service Technicians | 13 |
| 5e | Other Stakeholders | 13 |
| 5f | User Participation | 13 |
| 5g | Priorities Assigned to Users | 13 |
| 6 | Mandated Constraints | 14 |
| | | |
| 6a | Solution Constraints | 14 |
| 6b | Implementation Environment of the Current System | 14 |
| 6c | Partner or Collaborative Applications | 14 |
| 6d | Off-the-Shelf Software | 14 |
| 6e | Anticipated Workplace Environment | 14 |
| 6f | Schedule Constraints | 14 |
| 6g | Budget Constraints | 15 |

| | | |
|----|--|----|
| 7 | Naming Conventions and Definitions | 15 |
| 7a | Definitions of Key Terms | 15 |
| 7b | UML and Other Notation Used in This Document | 15 |
| 7c | Data Dictionary for Any Included Models | 15 |
| 8 | Relevant Facts and Assumptions..... | 15 |
| 8a | Facts | 15 |
| 8b | Assumptions | 15 |

I Project Description

1 Project Overview

The technological apex of our time is almost here. But it is unfortunate that building collapse accidents continue to happen, and we must protect our heritage places and pass them on to future generations so that they will appreciate our culture's past. A software program called the Structural Integrity Assessment System is designed to assist engineers who want to understand the advantages and disadvantages of a civil structure.

In this project, we want to accomplish that goal by utilizing sensors and a cloud platform that displays specific information about the position of the sensors and their value records. This data can be subjected to visual data analytics to display graphical distribution to the user, aiding in their understanding of the characteristics of the building site.

By completing this project, we will be able to access places where it is challenging for people to go and work, understand the stability of the structure in an efficient manner without requiring a lot of labor, and reduce hazards associated with structures falling.

2 The Purpose of the Project

The Structural Integrity Assessment System is a piece of software made to help engineers who want to comprehend the benefits and drawbacks of a civil project.
Accurate data

2a The User Business or Background of the Project Effort

Civil engineers, archaeology enthusiasts, and students pursuing construction management are among the prospective users of the suggested software program. Large skyscraper management firms frequently hire other businesses to provide structural maintenance services after receiving inquiries from a variety of clients. They are encouraged to evaluate a variety of elements, such as tilt, load and strain, and cracks, in order to identify structural faults. These businesses can use this program to cut labor costs and obtain accurate, efficient data.

In order to learn how construction site concepts are attained and maintained, architecture students frequently have to labor on-site. They can utilize this program to obtain comprehensive information and carry out the necessary analysis to discover pertinent facts.

2b Goals of the Project

The project's main objective is to make it easier for the user to evaluate civil structures. Due to their enormous scale, focusing on a building's strengths and weaknesses is frequently tricky. Using the web application or mobile app that displays graphical data about many aspects like temperature, tilt, crack, stress and strain, the user can quickly examine the status of the entire building.

2c Measurement

A structural integrity assessment system provides sensors and applications that will provide accurate information about the evaluated structure. The sensors are placed in different locations selected by the engineer, which will calculate the information and display tilt, strain, load, temperature and crack formations information. This data can be viewed on the application with graphs and precise values our competitors do not maintain.

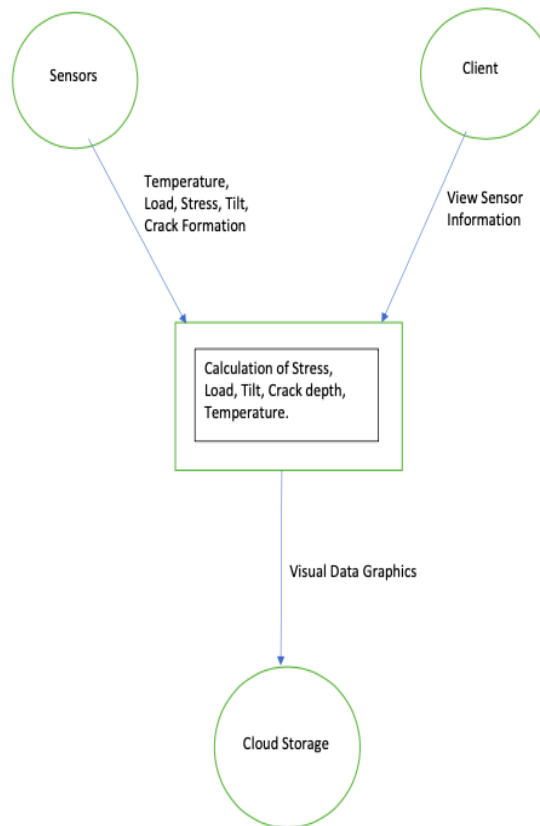
3 The Scope of the Work

Structural integrity evaluation The system is designed to give the user graphical information about the sensor data. The sensors return information that the user can utilize to comprehend the characteristics of the building. It is the user's obligation to comprehend this information and choose the appropriate structure.

3a The Current Situation

The customer now employs human labor to access challenging locations. They use old-fashioned methods, including digging alongside the foundation to look for cracks, pillar tilt, and stress. These methods can be expensive and risky because digging could result in the collapse of the structure. The data is inaccurate and time-consuming.

3b The Context of the Work



Your diagram and text goes here . . .

3c Work Partitioning

N/A

3d Competing Products

Other competitors on the market include move solutions, which have sensors and a cloud platform. Movesolutions offers a variety of sensors for usage in various applications. For instance, a tiltmeter can only be used to measure tilt.

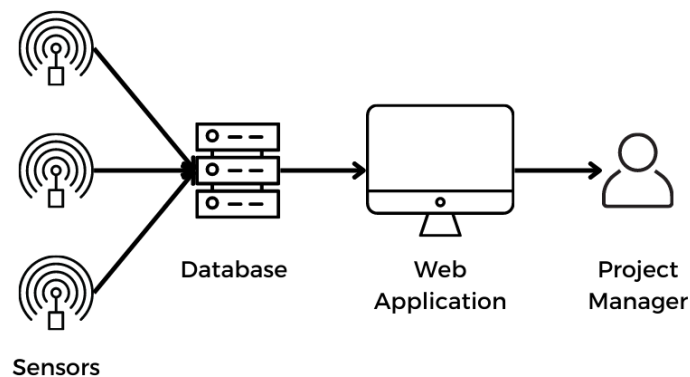
The suggested project is superior to previous projects since it uses a single sensor for various activities and has better precision and a more comprehensive operating range.

4 The Scope of the Product

It's tough for the naked eye to capture the structural wear and tear of a building. Small structural changes often result in severe damage to life and the economy. Usually, changes in the mechanical and geometrical properties are monitored by engineers using physical means. But a human would only be able to observe significant changes. Equipping the building with sensors only solves half the problem. The data generated by these sensors daily requires analysis and visualizations for a non-specialist to understand. Project managers should use the latest technological advancements to automatically analyze and monitor the robustness and strength of a civil structure. Project managers can use the structural integrity assessment system to obtain assessments and suggestions based on the data obtained from the sensors.

A structural integrity assessment system is software that helps users analyze sensor data and obtain assessments and suggestions. This is accomplished by employing sensors in the civil structure to get readings like measurement of angles on all three axes, temperature, frequency and amplitude of the vibrations and stress. The software analyses this data to assess tilt, crack formations, sinking abutments, strain, load shifts, monitoring of existing cracks, degradation of load bearings, risk-factor and suggestions.

4a Scenario Diagram(s)



4b Product Scenario List

1. Web application
2. User login and registration
3. Analyze the risk factor
4. Sensor database
5. Assessment report and suggestions

4c Individual Product Scenarios

1. Web application: A web application that displays user dashboard
2. User login and registration: The user has to login or register and request access to view the database and dashboard.
3. Analyze the risk factor: The assessment will be performed by using data analysis techniques to obtain the risk factor.
4. Sensor database: The database will store the sensor data and assessment parameters like risk factor
5. Assessment report and suggestions: After analyzing the data, a visualization of risk factors and suggestions are displayed.

5 Stakeholders

5a The Client

Big construction enterprises and small individual civil contractors or builders are some of our stakeholders. The range of stakeholders our product serves demonstrates how the civil industry can gain from us. To maximize the advantages of our solution, both major corporations and small individuals can invest in our technology.

5b The Customer

- Big construction enterprises

All the world leading construction companies which account for building huge civil structures including skyscrapers, industrial plants, airports, stadiums, etc.

- Small construction companies

Companies that take on construction projects to build structures such as small residential buildings & societies, mini shopping malls, etc.

- Individual builders

Small neighborhood constructors like builders working on row houses, shops and stores, small residential buildings, etc.

5c Hands-On Users of the Product

Though the solution ultimately aids the populace which will be residing or utilizing the civil structure in future, however, the solution is used by the ongoing-construction builders or post-construction inspectors to check the overall integrity of the structure.

There are two categories of Hands-On users:

1. Construction Managers & Engineers-

These are users involved during the construction phase of a structure, the time between the start of actual structure construction and its completion. Due in part to its prominence, the building stage is the one that majority people connect with construction works.

2. Construction Inspectors and Structural Engineers-

A residence or building's load-bearing structural components, such as the foundation, structural frames, planks, supports, or pillars/stanchions, are confirmed to be sound by these inspectors.

User part- Examine structure readings and read & understand the data provided by the application.

Subject understanding- Knowledge about civil structures, what factors affect the integrity, and benign structural readings.

Experience- Users should have experience of civil constructions and a little idea about working with software application interface, and reading sensor data.

5d Maintenance Users and Service Technicians

Basic hardware and software aptitude should be a must for installation team, maintenance team and service technicians. The software professionals should patch upgrades and problems. The IT team and technicians could offer assistance to consumers using our solution. Moreover , service professionals need to be able to resolve any minor problems with a device that are primarily hardware-related.

5e Other Stakeholders

- Agencies working on structures within areas prone to higher risk of natural disasters are also our potential clients
- Government organizations interested in assessment of structural integrity of various public buildings & constructions
- Government agencies responsible for maintaining important monuments and tourist attractions
- Partner Companies- These are middle companies which will help increase the reach of our products to more consumers and aid in expanding the overall business, locally as well as internationally
- Individuals- People interested in checking structure strength on an individual level for their personal properties or a group interested in building a larger and more advanced project using our product as a small part.

5f User Participation

Through contact support like email service, users can make improvements and offer crucial feedback. Any unique opinions regarding our hardware units or software application are appreciated to help us produce a better final version of our solution. Additionally, engineers and construction professionals are welcome to offer specific additions for our system.

5g Priorities Assigned to Users

Direct buyers of our solution including big and small construction enterprises, and individual builders prioritize first in our importance and priority list. Their requirements and feedback are more significant than other stakeholders and users. The partner companies which will help expand our business further will receive priority as they'll be the middleman between the buyers and our team, and will transfer information about requirements for buyers to us. We will also give priority to people who utilize and reside in constructions that use our system as these people directly interact with the structures.

Competitor firms that buy our product to learn and compare with their own will be considered under unimportant users.

6 Mandated Constraints

6a Solution Constraints

Description: Our software service is maintained in a Cloud environment, so any application platform including mobile, website, or tablet will be satisfied.

Security constraint: For engineers, they must work on company provided laptops for security purposes while clients can access the maintenance website with their login credentials.

Description: Since this project and service contains highly detailed construction and structural information, its security constraints are the maximum. Its purpose is to prevent any harmful exploitation of our data to illegal or any other activities that are not related to our business logic.

Rationale: This software product will be marketed for businesses such as building maintenance, civil engineers, construction companies, and other academic institutions that collaborated on our project for improving our work and structure safety.

6b Implementation Environment of the Current System

This project contains two main departments such as sensor application on a structure including structure inspection and evaluation and software development.

Sensors are correctly installed after the structure inspection. The sensors send data such as vibration, tilt, and heat to the facility that commutes the data and evaluates the outcome.

Since there is a limitation in communication between sensors and a software environment that computes data, it is favorable to have a room within one or two miles that handles the incoming signals for better structure maintenance and data preservation. It helps convert and amplify sensor data for software implementation.

For the software implementation, we implement a cloud environment. The main reason is the extensive data, computation power, and accessibility. However, the database is maintained locally because our data contains detailed building information.

For this reason, we require developers and clients who access the service to have a high security clearance.

6c Partner or Collaborative Applications

This application is composed of sensors, cloud service, and database applications, we collaborate with other parties such as a cloud service provider such as AWS and research institutions.

We collaborate with sensor manufacturers for adjustments and other specifications of sensors that are based on the customer's needs. Since we expect to evolve, the sensors will also be changed for the better customer needs and experience.

Cloud service providers will be one of the big partners for this project since we have to use the power of cloud computation when we compute the large data.

Research institutions are the backbone of our future, therefore, we provide less sensitive data for research purposes and gain mutual benefits from the research outcome.

6d Off-the-Shelf Software

To maintain maximum security and strict access level, our database is maintained locally. Its information is confidential so that customers and other engineers have no access to the actual database, but only computed data.

6e Anticipated Workplace Environment

There are two types of environments: Sensor environment and Software deployment.

The sensor environment will be dependent on the structure. This prototype project is not to be used on Mars or the Deep sea. It is only for the structures that are grounded on earth. Each sensor will be used on basements, pillars of bridges, resident buildings, and other skyscrapers.

To satisfy such extreme conditions, the sensors must be waterproof, heat resistant with long battery life.

For the software environment, we expect to deploy our project on a cloud environment, so that clients and developers can easily access and use the software around the globe.

6f Schedule Constraints

The time frame of the project will be divided into 5 main sections. Building inspection, cost evaluation, sensor installment, software building and testing, and maintenance.

All of the sections will be closely monitored and developed with clients. The building inspection time depends on the size of the structure, but it should not exceed 3 weeks.

For the cost evaluation process, it involved financial analysts, project managers, sensor manufacturers, and our engineers for sensor inspection. Since many parties are

involved in this step, we expect to finish cost evaluation as soon as the building inspection is finished. Schedule of cost evaluation will approximately be 3 weeks.

Since we apply a new code base for this project scenario, the software building and testing stage must start with the beginning of this project. It must finish around the same time as cost evaluation before sensor installments. It means it needs to be finished in 6 weeks.

The maintenance will be widely tested and monitored after the project is done. It is one of the final steps that we take in this project. If time allows, this stage must take at least a year to prove the working of this project. The time frame is 1 year since the structure and sensors have to be tested from winter or hat summer over the course of each season.

6g Budget Constraints

To prepare and build the application, the budget is one of the main constraints along with development time. The cost of sensors is evaluated by civil engineers and clients. It is one of the most important and versatile constraints that meets the consumer and merchant's needs.

Each sensor cost varies based on the time of purchase because the cost of the semiconductor and other sensors are dependent on the global market. Upon a purchase, we guarantee that the communication with the client will be clear as our business logic and it will be totally dependent on the client's decision.

The deviation of the budget spending on sensors should not exceed 2.5 of the global market price.

7 Naming Conventions and Definitions

7a Definitions of Key Terms

Not Applicable

7b UML and Other Notation Used in This Document

Not Applicable

7c Data Dictionary for Any Included Models

Not Applicable

8 Relevant Facts and Assumptions

8a Facts

- Most civil structures and monuments are inspected manually, though using mechanism and devices, but are still not automated

- Currently structures which are under construction are laid out one step at a time. A certain amount of wait time is dedicated between two steps for materials like concrete to dry out and strengthen internally. Leading construction companies are in search of systems that can evaluate a civil structure and concrete while under construction in order to save the waiting time between the stages of their constructions.
- Discovering, spotting, determining, and evaluating are important steps that require input of the preceding step.
- Signal Processing is crucial to convert the sensor data to understand integrity of the structure in hand

8b Assumptions

- Compact sized sensors exist that can measure important factors such as tilt, crack formation, stress, strain, load shifts, degrading abutments or load bearings, etc.
- Sensors range is adequate enough to give measure of important factors within 20 feet of range
- Sensors are robust, sturdy, and long-lasting for many years without requiring any maintenance
- Places where sensor devices are placed are well within wireless internet access
- Sensors might be disrupted due to external human activities such as drilling on a wall, giving vibrations that are misread
- User has sufficient knowledge of factors affecting civil structure's strength
- User possess a computer device and knows how to operate a computer and run an application
- User should also be able understand important data values from the system