Lab 1 - Load.In Product Description

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1. Introduction

Every year an average of 31 million people move across the United States, with most of these moves being done by DIY movers. (Wood, 2020). With the average American moving 11.7 times in their life, most people will understand the process can often be tedious and time consuming (Wood, 2020). The do-it-yourself mover is often inexperienced with the logistical aspects of moving including cost estimation, proper packing and loading of boxes, and keeping track of their item's locations. Often a professional moving service can provide many benefits to the customer including packing assistance, loading and transportation of all their items to their desired location. However, with the average cost of an interstate move being $4,100, many people are unable to afford a professional mover (Wood, 2020).

With all the issues that arise during the moving process, it seems necessary that an application is created that can help the do-it-yourself mover during such strenuous times. This is where Load.In comes in. Load.In will provide the end user with an easy-to-use program that allows them to organize their move by being provided with a plan and tips to maximize their efficiency and minimize the costs associated with moving. Through the use of Load.In the do-it-yourself mover is able to make their move as easy as possible.

2. Load.In Product Description

Load.In is a mobile and web application that is the solution for many issues that arise during the moving process. The goal of the application is to help the do-it-yourself mover save time and money while increasing the speed and efficiency of their entire move. Users may create an account that allows them to begin inputting information relevant to their move such as the start and end location of their move and an estimation of items that are going to be moved.

Once this initial information has been entered, the user is provided with an estimation of needed trips, move time, and the size of truck needed. The user can then begin generating 3D models of their furniture and items within their home, and all of these generated models will be stored within the applications database. After the user has entered the items that they have in their home into the application, a load plan is generated that shows the user how to properly pack their boxes and how to load them into their vehicle.

Once the user has loaded all of their possessions into their vehicle, they are then able to view where certain items are located within their vehicle. If the user encounters an issue during the moving process such as a unique item, they can access a chat-bot system that can provide them with expert tips that pertain to their situation and if needed they can get live support to help them.

After the user has completed their move, they can leave reviews of the application, their move plan, and any help they received from the chat-bot or live move experts. On the back end of the Load.In system, anonymous analytical data is gathered from the moves, and this data helps increase the efficiency of the product and user satisfaction.

2.1 Key Product Features and Capabilities

The main feature of Load.In is the ability to generate a customized load plan that is created from the information entered by the user. Load.In achieves this by having the user generate 3D models of all the items in their home and providing measurements for large or abnormal furniture. After the user has entered all relevant information, the application creates the load plan which will provide detailed instructions on how to properly pack their boxes and load their vehicle.

All of the items that are entered by the user are stored into a move inventory database. This feature allows the user to generate a new load plan if they encounter an error or feel that the plan being given is not correct. Once the user indicates that they have completed their move, the application will delete this database as to not store any user information.

Load.In provides rental estimations to the user including estimated number of trips, estimated time needed to complete their move, and estimated cost of rental trucks based upon their vehicle size. This information is generated using third party vendor information and past anonymous analytical information that has been gathered through the use of Load.In.

During the moving process if the user encounters a situation that is unusual, or the load plan has an error, they can search through a database of expert tips based on keywords. These tips contain suggestions for packing and loading items that may not be found in every household such as large or oddly shaped furniture. These tips are gathered from move experts that create articles for the application for situations they have encountered in their professional experience. If the user finds an article that pertains to their situation, they can leave a review based on how the article was able to help them.

Alongside a database of articles, the application includes a chat-bot feature that allows the user to interact with an artificial intelligence that can help them search through the database

more efficiently to find a useful article faster. If the chat-bot feature fails in helping the user, then the user can be connected to a live support agent who can help them with their situation or error.

In the back-end system of the application, Load.In utilizes third party vendor synchronization that pulls data from vendor systems and databases and allow Load.In to properly estimate truck prices and availability based on user location. Alongside these third-party applications, a web scraper can scrape relevant data from the internet to help increase the accuracy of these estimations.

Throughout the entire moving process, Load.In gathers analytical data that helps lead to increased accuracy as the number of users increases. Some of the types of data that may be gathered include location data, move cost data, feedback data, and anonymous user inventory. The location data may include the start and end locations of a move and the number of trips needed along with the total distance traveled. Move cost data may include all costs associated with the move including gas, cost of rental vehicle, cost of supplies used during move, and time needed to load and unload the vehicle. Feedback data includes all the ratings provided by the user for the entire application experience and any individual expert tips they received during their move. Lastly, anonymous user inventory may include number of items, average size weight, and any abnormal furniture that was encountered. All data is anonymous and only used for the analysis and improvement of any estimation algorithms being used within the application to improve the user experience.

The heat map feature of the application is used for developers to analyze the utilization of smartphones. The heat map tracks what the users are accessing the most on the application and how often features are being used to help developers decide what needs to be improved upon.

Some issues that the heat map may help solve are difficult to navigate user interfaces that may reduce the user experience.

2.2 Major Components (Hardware/Software)

Load.In consists of a web application and a smartphone application. Shown in Figure 1 is the major functional component diagram (MFCD) for Load.In. The figure provides insight into how Load.In functions with the user using their personal smart device to use the mobile application to perform all of their 3D scans and move inventory input. All of this information is passed into a database and run through the algorithms in place to provide the user with their load plan.

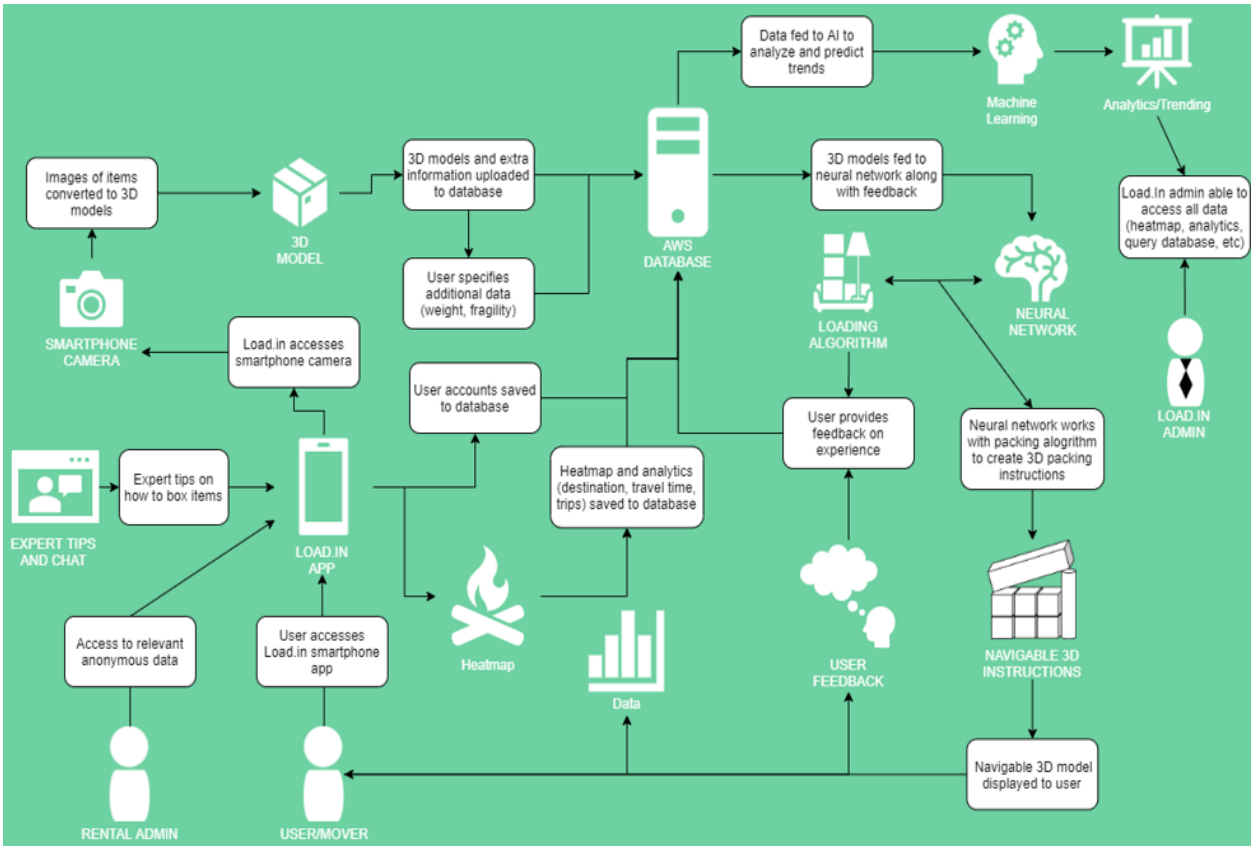

Figure 1. Load.In Major Functional Components Diagram

For the hardware, the most critical component for the success of Load.In is the database which is based in the cloud to reduce resource demand on the user's devices. The database uses

Amazon RDS which is compatible with MySQL and Amazon's Lambda. The database needs to be able to store large amounts of information so that it may all be processed to provide usable output to the user. Along with this, some of the information that is stored in the cloud can be used by developers and administrators for analytics to provide a better user experience and service in the future. The core of the work falls upon the smartphone of the user which needs to meet a few standard requirements. Some of these requirements include, Wi-Fi connectivity, a 12-megapixel camera, 4Gb of RAM, and a 8 core processor. For the web application, it can run on a computer which uses Linux, Windows, or Mac OS. The Android application is programmed in Java and can be run on modern Android operating systems found on smartphones. The web API uses AWS Elastic Beanstalk and Apache CFX with Tomcat. The vendor synchronization portal uses AWS Lambda to be triggered on a schedule to draw data from various vendor websites.

3. Identification of Case Study

As Load.In is being developed to help the average do it yourself mover, the case study will be focused on a typical move that may be encountered using average variables collected from the analysis of move statistics across the country. This leads to a scenario where the move is within the same city and within a twenty-mile radius of the original location. The house size will be around 2,200 square feet and will contain the items of a three-person family that has one dog with this data being drawn from the U.S. Census Bureau (2019). The family will need to rent a vehicle for their boxes, which will allow the utilization of Load.In's estimation features. For items in the home, the family will have common furniture found in many households. To take advantage of Load.In's ability to share load plans among smart devices, the case study will include friends or family of the user helping them during their move. Since the case study is targeting the average scenario that the product will face, oddly shaped items will be excluded since they are only one factor in the problem that Load.In will help solve. The goal of conducting such a case study on an average home is that Load.In development team will be provided with vital feedback on how the application behaves given the scenario it will most likely be used for. Along with this vital information the case study will show how the application can be scaled upwards or downwards in terms of distance of the move, or the size of the home, vehicle, or items.

4. Product Prototype Discussion

4.1 Prototype Architecture (Hardware/Software)

The Load.In prototype will be able to operate entirely on a single virtual machine using the Ubuntu Linux operating system. The prototype will use various Docker containers, one to be used for the Apache Tomcat and CFX programs for the web API. Another will contain the MySQL database that will be used to store all move data. Apache Tomcat will be the server that hosts the CFX web API that provides the connection between the android application and the MySQL database. Along with these services, a test harness will be developed to provide an interface for testing and demonstration purposes. The test harness will also be used in testing the edge cases that may arise throughout a typical move process.

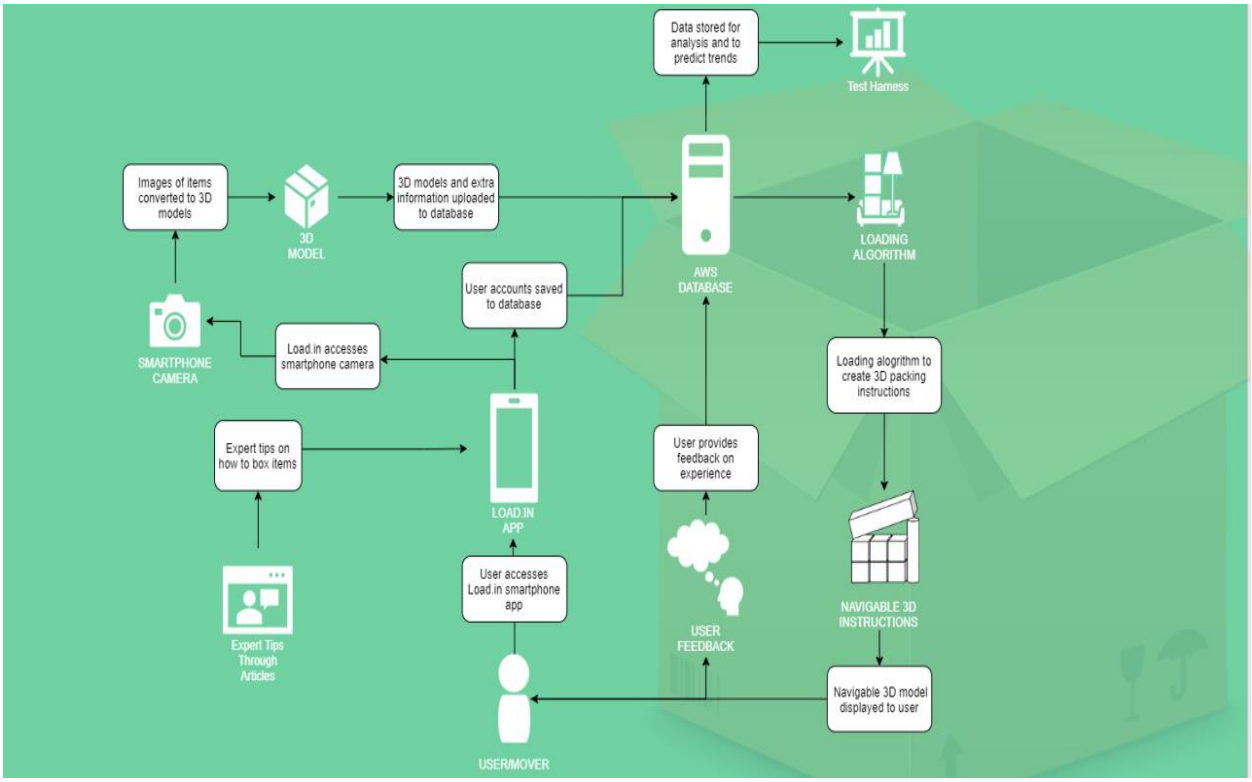

Figure 2. Load.In Prototype Major Functional Components Diagram

4.2 Prototype Features and Capabilities

To provide a working product within the time frame given, the Load.In prototype will only include features needed to provide a successful proof of concept to potential users. As seen in the major functional components diagram in Figure 3 above, the main interface for the prototype will be the android application on the user's phone. Using the user's phone, they will be able to create a 3D model of the item. If for some reason the user is not able to use the camera on their phone, they can manually enter the measurements of their items. Once the item measurements have been entered in the application, this information will be uploaded and stored into a cloud database. The user will then be provided with a load plan which will provide them with instructions on how to load all the boxes into the vehicle based on the available space. If for whatever reason the user does not agree with the load plan being provided to them, they will have the ability to reset the program and have a new load plan generated. During the moving process if the user encounters a strange item that they are unsure of how to pack they can use keywords to search for articles that will provide advice on how to pack that item. After the move has been completed, the user will be given the opportunity to provide feedback on their experience so that the Load.In prototype can be improved upon during future iterations. Through the implementation and success of these selected features it allows the end user to see the innovation that Load.In provides and showcases the scalability of the application as many of these features can be expanded on to include more vehicles and more extreme edge cases.

4.3 Prototype Development Challenges

While the prototype being developed for Load.In will attempt to address any edge cases that could be encountered during the moving process, it is impossible to address each possibility. A key functional component of the application is the test harnesses' ability to update the values in the database and have the load plan updated to provide a plan for the user. If a random number

generator is used the prototype may run in to an issue if extremely large or small numbers are created. Another issue that could arise is the article suggestion function that will show the user tips based on a specific item they are trying to pack. If the user is attempting to pack a odd family heirloom that has not been addressed before, and an article is provided that is not able to help them this makes the feature useless for the user. The best mitigation for these problems will be constant testing and updating for the edge cases that arise as the prototype is being developed and more test cases analyzed.

5 Glossary

3D – Three Dimensional

Administrator – Someone who will access elevated features of the Load.In system in order to maintain and detect issues.

Amazon Lambda - a serverless compute service that lets you run code without provisioning or managing servers

Amazon RDS - Amazon relational database service

Amazon Web Services (AWS) – A cloud platform on which Load.In's databases are hosted.

Android - a mobile operating system based on a modified version of the Linux kernel and other open-source software

Application Programming Interface (API) – An interface for programs to share information and functionality with one another through a series of call or connections.

AWS Elastic Beanstalk - an orchestration service offered by Amazon Web Services for deploying applications which orchestrates various AWS services, including EC2, S3, Simple Notification Service, CloudWatch, autoscaling, and Elastic Load Balancers

AWS Elastic File Storage – an AWS service that provides file storage with the ability to auto-scale up with increased demand.

Apache CFX – A popular library for hosting web apis.

Apache Tomcat - an open-source implementation of the Java Servlet, JavaServer Pages, Java Expression Language and WebSocket technologies. Tomcat provides a "pure Java" HTTP web server environment in which Java code can run

Chatbot – A feature within Load.In that provides information to users and guides them towards helpful articles and other resources interactively.

Cloud – A term used to describe several computing models such that a company or individual can purchase resources for hosting a variety of things in a centralized location accessible from anywhere in the world.

Computer Vision – a subclassification of Artificial Intelligence that involves computing information about the world from various sensory data, such as images. Techniques of this classification are used throughout Load.In to observe real world objects.

CPU – Central processing unit.

CSS – Cascading style sheet.

Do-It-Yourself (DIY) Mover – Non-professional movers that rent a truck for their move, but and handle all packing, unpacking, manual labor themselves. This is the primary end user of Load.In

Expert Tips – Feature of Load.In that allows for a mover to search for helpful articles pertaining to a variety of useful information on how to accomplish various tasks during a move.

GHZ – Gigahertz

Guest – Someone who is accessing the Load.In system anonymously and has not registered for an account or someone who has registered but has not authenticated to the system at the time of access.

GUI - graphical user interface, the aspect of a software program that the end user interacts with.

HTML5 – Hyper Text Markup Language version 5

Java - a set of computer software and specifications developed by James Gosling at Sun Microsystems, which was later acquired by the Oracle Corporation, that provides a system for developing application software and deploying it in a cross-platform computing environment

JavaScript - A scripting language that runs in the browser and performs one or more function to animate an otherwise static HTML document.

Linux - An open-source and community-developed operating system for personal computers and work stations.

Load Plan – A set of instructions on how to optimally load a container, generated automatically by Load.In from the boxes and furniture input into the system by the user.

Logistics Planning – A feature of Load.In that assists the mover with determining what rental trucks cost, how many trips the truck might need to take and whether the truck is available to rent based off proximity to the mover.

Mbps – Mega-bits per second, a unit of measurement for network speeds.

Megapixel – One million pixels, typically used to measure the size and quality of images

Move Inventory – A feature of Load.In that catalogs all boxes and items the mover intends to move.

MySQL - an open-source relational database management system

MacOS - An operating system used on Apple's MacIntosh line of personal computers and work stations.

Operating System (OS) – A collection of programs designed to provide a platform on a device to run other applications and typically provides a layer of abstraction from the hardware it interacts with.

Pixel – A small square of color that is part of a larger display screen or image.

Photogrammetry – A computational method of deriving three-dimensional information from images. This method is used in Load.In to construct 3D models of boxes, furniture, and other items from pictures taken from the end user's cell phone camera.

Portable Network Graphics (PNG) – Portable Network Graphics, a common image file format that Load.In uses

Professional Mover - Professionals who handle the physical labor of loading and unloading a moving truck, as well as driving the truck to the destination.

Rental Administrator – A representative of a rental company who will access the Load.In system on behalf of the rental company.

Rental Company – Any company which rents moving vehicles for a Do-It-Yourself Mover to assist them with their move.

Smartphone – A device, typically handheld, which can act as both a cellular phone and a computer by running one or more applications through typically a touch screen interface.

SPRING MVS - an application framework and inversion of control container for the Java platform

Test Harness – A set of special features used during the development of Load.In to enable testing and demonstration of the application

Vendor Synchronization – A feature of Load.in that brings in truck sizes and availability of rental information from third party moving company websites.

Windows – An operating system developed by Microsoft for use on personal computers and work stations.

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