**1. Problem**

**1.1 Historical Introduction**

When beer was first developed 4,000 years ago, it was stored in containers such as clay urns and pots. Over time, however, brewers found that storing beer in wooden casks allowed it to be carbonated and fermented more easily. Eventually, stainless steel and aluminum containers, referred to as kegs, became the preferred beer storage method [1], [2].

Kegs were invented to allow pasteurization of liquids inside, such as beer [2]. With these metal beer containers, the way to determine the amount of beer inside without contaminating the contents is to roll the kegs onto a scale or purchase an expensive interior redesign from other companies.

Scales as a tool to weigh commodities date back to ancient Egyptian and Babylonian times. Historically, scales were made using wood, a cord, and pans supported by cord. This “equal arm” balance was used for the next 2000 years until the Roman steelyard scale was developed [3]. Modern-day scales use load cells, which transform pressure into current, and are the main technology used in the modern competition for measuring keg levels [4]. In today’s market, keg scales are priced on an average of $200-$300 [5].

ALLDET will provide a way for keg owners to determine the amount of liquid in their containers without having to move them, weigh them, or spill any liquid. Our product will provide a non-invasive, hands-free method for level monitoring that requires no new taps or lines, all while maintaining a lower price point than our main competitors.

Numerous companies provide beer inventory tracking and monitoring. Their solutions, however, require physical reconstruction of tap walls as they use proprietary beer taps to monitor flow control. In addition to the cost of downtime due to reconstruction, these are large initial costs.

**1.2 Market and Competitive Product Analysis**

As mentioned above, one popular method currently available for determining the liquid level in a container uses scales to determine the weight of the keg and its contents. This method is not ideal because it requires the customers to lift their containers from their serving station or take them off of the storage rack to place on the scale and manually calculate the amount of liquid remaining. Attaching the device to the side of the containers prevents heavy lifting, making our product more accessible than other options currently on the market. Manual entry of data increases the likelihood of incorrectly recording the liquid level as well as causes employees to spend more time on tedious inventory tracking. Our product automates the entry and analysis of data, allowing employees to spend their time on more important issues.

Another method available involves specialized bar taps and/or lines that have flow meters and sensors. This requires new construction of displaying taps to put the new product in place [6]. Our product differentiates itself in that it can be easily attached and removed from the container rather than modifying the keg or line.

The restaurant industry is our primary market. We aim to target bars, restaurants, alcoholic beverage vendors, and at-home breweries. Our customer base can include chain or locally owned businesses. Restaurants have a high enough usage rate that they could greatly benefit both from an automated method of determining the level of liquid in their containers as well as the data analytics associated with usage rates. Several flow monitoring systems are already available. Businesses that have such systems installed are outside of our market, as they already have expensive equipment against which we could not provide a competitive performance alternative.

**1.3 Concise Problem Statement**

ALLDET’s mission is to provide a simple, easy-to-use solution for liquid level tracking in a container. We intend for our solution to be affordable, quickly set up, and easily detached and moved to a different keg. Attaching the device to the side of the container prevents heavy lifting and back strain on our customers, which is unavoidable using other methods involving scales. In addition, it does not require invasive procedures like redesign of a storage area or contact with the liquid itself.

Our product will utilize a vibration sensor for measuring the resonance that is created by a small mechanical arm that will strike the side of the container. The data from the sensor will be sent to a microprocessor to be analyzed before being passed on to the application. We will use a Bluetooth connection between each module and the device running our application to send the data. Our application will have a user-friendly interface to provide our customers with many useful features including estimated liquid level, alerts on when to reorder, and usage history. Our product is a simple, affordable, non-invasive solution to challenges seen in the restaurant/bar industry.

**1.4 Implications of your Success**

Many man hours are spent handling kegs in the restaurant/bar industry. This can include moving, stacking, and weighing the kegs for inventory purposes. In 2018, 202.2 million kegs of beer were sold, and over 600,000 retailers were selling alcohol [7]. If we estimate each one of these establishments spends half an hour per week on keg inventory, then each one would spend over 3 business days per year measuring the liquid level of their beer kegs. Providing a hands-free solution, ALLDET would eliminate the time wasted on manual labor for keg inventory, thus saving customers thousands of dollars.

ALLDET is pioneering the way beer keg level is monitored and tracked. Providing an innovative, long overdue solution to an entire industry will set a new standard of how inventory management is accomplished. Our device will help customers save time and money spent on inventory, as well as detect overpouring and theft due to free drinks. Upon further success, ALLDET devices could be used for chemical containers, oil drums, propane containers, or any other type of fluid stored in a metal container.

**References**

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