Design and Fabrication of Automated Mashing Machine

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Declaration of Authorship

Bangladesh, hereby declare that the internship report titled **—Design and Fabrication of Automated Mashing Machine** is prepared aster the completion of my internship at Design and Fabrication of Motorized Spring Assist Mashing Machine. We also declared that the internship report is prepared for an academic purpose and has not been submitted by me before of any degree.

We declare that the internship report embodies the result of own research work, perused under the supervision of **Nuruzzaman Rakib**, Assistant Professor, Department of Mechanical Engineering Sonargaon University (SU)

We also confirm you this report from any counterfeit and no other student either B.Sc.
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Abstract

A big market exists for machineries in food processing. For each different type of cooking there exist a different variety of vessels and machines. For mashing one can find a variety of devices and machines. However, some are small and simple devices and other are big and bulky machines. The Mashing Machine, our mini project, is a medium scale machine that combines the cam and shaft mechanism and spring mechanism. A motor rotates the shaft, the shaft in turn rotates the cam. The masher is connected to the cam through linkages and spring mechanism. The frame is mostly made from mild steel.

Keyword: Motor, Automation, Mild steel.

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Chapter 1

Introduction

1.1 Introduction

In the ever-evolving landscape of industrial and commercial processes, the need for efficiency, precision, and automation has become increasingly paramount. Enter the Motorized Spring Assist Mashing Machine, a cutting-edge tool designed to revolutionize the way materials are mashed, processed, and prepared across a range of industries.

This innovative machine represents a culmination of engineering excellence and technological sophistication, bringing forth a solution that not only alleviates the physical demands on operators but also ensures consistent, high-quality results with unparalleled precision. Whether in the realms of food processing, pharmaceuticals, materials testing, or beyond, the Motorized Spring Assist Mashing Machine has firmly established itself as an indispensable asset.

At its core, this machine combines the power of motorization with the finesse of spring-assisted mechanisms to facilitate and enhance the mashing process. It can efficiently process materials, whether they are food products, pharmaceutical ingredients, chemical compounds, or samples for mechanical testing, with a level of control and consistency that is simply unattainable through manual methods.

As we delve deeper into the realm of Motorized Spring Assist Mashing Machines, this comprehensive exploration will shed light on their inner workings, versatile applications, advantages, and even the challenges they may pose. It will also highlight how these machines are pushing the boundaries of efficiency, quality, and innovation across diverse industries, and where their future innovations may lead us.

Join us on this journey through the world of Motorized Spring Assist Mashing Machines, where technology and ingenuity converge to reshape the way we mash, process, and create, one application at a time.

1.2 Purpose of the Study

The purpose of studying Automated Mashing Machines can vary depending on the context and the specific goals of the research or investigation. Generally, the study of these machines serves several important purposes:

- Understanding Machine Functionality
- Improving Efficiency
- Enhancing Product Quality
- Innovation and Design
- Cost Reduction
- Customization
- Hygiene and Sanitation
- Safety
- Materials Testing
- Environmental Impact
- Regulatory Compliance
- Future Developments

In summary, the study of Automated mashing machines serves multiple purposes, ranging from improving efficiency and product quality to enhancing safety and sustainability.

1.3 Objectives

The objectives of Automated Mashing Machines can vary depending on the industry, application, and specific goals of the machine's use. However, there are several common objectives associated with these machines:

- To improve efficiency
- To make easy and affordable design
- To improve safety
- To reduce cost

Chapter 2

Literature Review

2.1 Literature Review

A literature review on automated mashing machines reveals a growing interest in this technology across various industries, particularly in food processing, pharmaceuticals, and materials testing. Researchers and manufacturers have explored different aspects of these machines, including their design, applications, performance, and potential for automation. Here's an overview of some key findings and trends from the literature:

Design and Engineering Aspects:

S. M. S. Moghe K discussed Researchers have focused on optimizing the design of motorized spring assist mashing machines to improve efficiency and reliability. Studies have explored the selection of materials for machine construction, considering factors like durability, sanitation, and corrosion resistance. Innovations in spring mechanisms and motor control systems have been investigated to enhance the precision and consistency of the mashing process.[1]M. Bruzzone and A. Wieler discussed about The integration of advanced control systems, such as PLCs (Programmable Logic Controllers) and HMI (Human-Machine Interface) panels, has been discussed as a means to automate and optimize the mashing process. Some studies have explored the incorporation of sensors and data acquisition systems for real-time monitoring and quality control.[2]N. Mahantesh, P. S. Birje, R. H. Challagidad, and T. Manisha have discussed future directions for research and development, emphasizing the need for smarter, more automated, and environmentally friendly mashing machines. Integration with Industry 4.0 concepts, such as IoT and data analytics, has been proposed as a way to enhance machine performance and predictive maintenance.Overall, the literature on motorized spring assist mashing machines reflects a growing awareness of their benefits and potential across multiple industries. Ongoing research and innovation in design, control systems, and materials aim to address challenges and unlock further capabilities in these machines.[3]

Chapter 3

The Design Methods and Procedures

3.1 Introduction

This section will introduce the components that make up the Design and performance analysis of a Motorized Spring Assist Mashing Machine and discuss their working and features.

3.2 Block Diagram

Figure 3.1: Block Diagram of Motorized Spring Assist Mashing Machine

3.3 Circuit Diagram

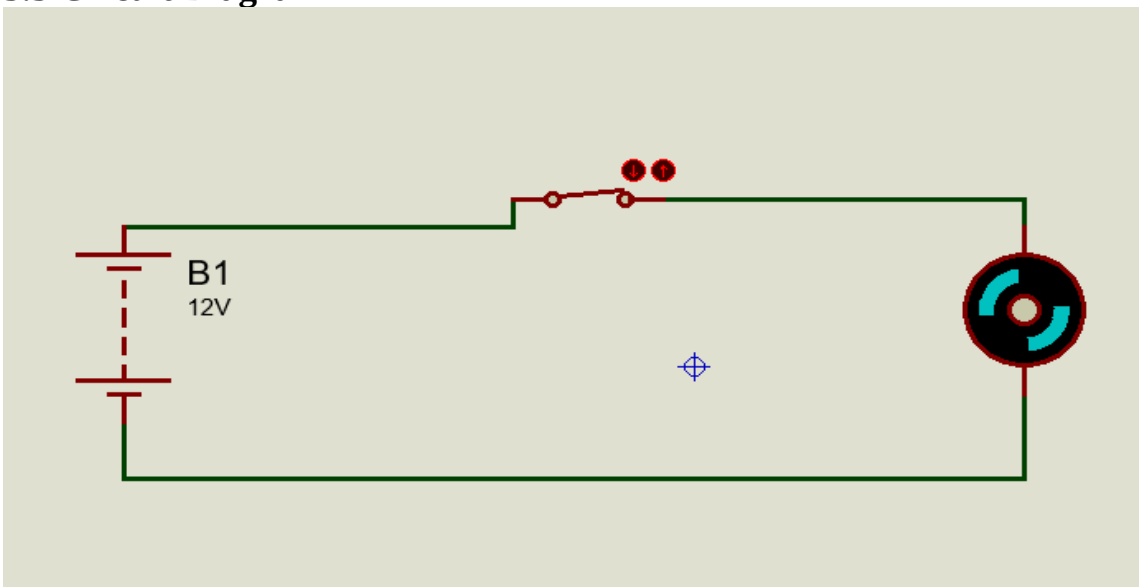
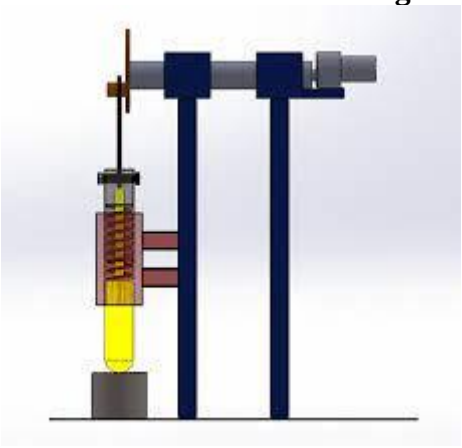


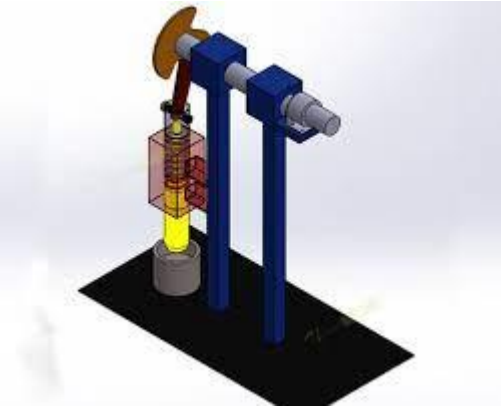
Figure 3.2: Circuit Diagram

3.4 3D Design

Picture 3.3: Side view Design



Picture 3.4: Front View



Picture 3.5: Side view Design

3.5 Working process

The Mashing Machine, our mini project, is a medium scale machine that combines the cam and shaft mechanism and spring mechanism. A motor rotates the shaft, the shaft in

turn rotates the cam. The masher is connected to the cam through linkages and spring mechanism. The frame is mostly made from mild steel.

A power source, usually a battery is connected to motor. The motor rotates the cam. Linkages of suitable length connected to cam helps in converting the rotating motion to reciprocating motion. The reciprocating motion causes the masher to move up and down. The spring attached to masher helps in increasing the applied force on the masher.

As the motor rotates it also rotates the rounded rod connected to motor shaft. Now the cam also rotates with the rod movement which is linked to the masher head with a spring. As the cam rotates the masher head is pulled up and released, between I is released it is released with added pressure from the spring driving it into the bowl with more pressure.[4]

Chapter 4
Equipments and Working Principle

4.1 Introduction

In this chapter we will discuss about components and their description.

4.2 Components

- Motor
- Shaft
- Cam
- Linkages
- Spring
- Masher Head
- Bowl
- Supporting Frame
- Nuts & Bolts
- Mounts and Joints
- Base Frame
- Screws and Connectors
- SMPS

4.3 Motor

A DC motor, or direct current motor, is an electrical machine that converts electrical energy into mechanical motion. It operates based on the principles of electromagnetic induction and the Lorentz force law. DC motors are widely used in various applications, from small household appliances to industrial machinery and transportation systems.

Here are some key features and components of DC motors:

Stator: The stationary part of a DC motor is called the stator. It consists of permanent magnets or electromagnets that create a magnetic field.

Rotor: The moving part of the motor is called the rotor or armature. It contains coils of wire (windings) that carry the current and interact with the magnetic field to generate mechanical rotation.

Commutator: The commutator is a split-ring or segmented cylindrical device attached to the rotor. It helps change the direction of the current in the armature windings as the rotor rotates, allowing continuous rotation in one direction.

Brushes: Brushes are typically made of carbon or other conductive materials and are in contact with the commutator. They supply electrical power to the rotor windings and maintain the electrical connection as the rotor turns.

Armature Windings: These are coils of wire wound around the rotor. When a current flows through these windings, they create a magnetic field that interacts with the magnetic field of the stator, producing a torque that causes the rotor to rotate.

Figure 4.1: DC Motor

4.4 Shaft

Figure 4.2: Shaft

The term shaft usually refers to a component of circular cross section that rotates and transmits power from a driving device, such as a motor or engine, through a machine. Shafts can carry gears, pulleys, and sprockets to transmit rotary motion and power via mating gears, belts, and chains.

4.5 Bearing

Figure 4.3: Bearing

The main purpose of bearings is to prevent direct metal-to-metal contact between two elements that are in relative motion. This prevents friction, heat generation and ultimately, the wear and tear of parts. It also reduces energy consumption as sliding motion is replaced with low-friction rolling.

4.6 SMPS

Figure 4.4: SMPS

SMPS stands for 'switch-mode power supply', is an electronic power supply device that is responsible for converting (high voltage) AC power into DC power (in lower voltage) for example, personal computer.

4.7 Working Principle

The Motor Rotates the Cam. Linkages of suitable length connected to cam helps in converting the rotating motion to reciprocating motion.

Chapter 5
Results

5.1 Introduction

This innovative machine represents a culmination of engineering excellence and technological sophistication, bringing forth a solution that not only alleviates the physical demands on operators but also ensures consistent, high-quality results with unparalleled precision. Whether in the realms of food processing, pharmaceuticals, materials testing, or beyond, the Motorized Spring Assist Mashing Machine has firmly established itself as an indispensable asset.

5.2 Design And Construction

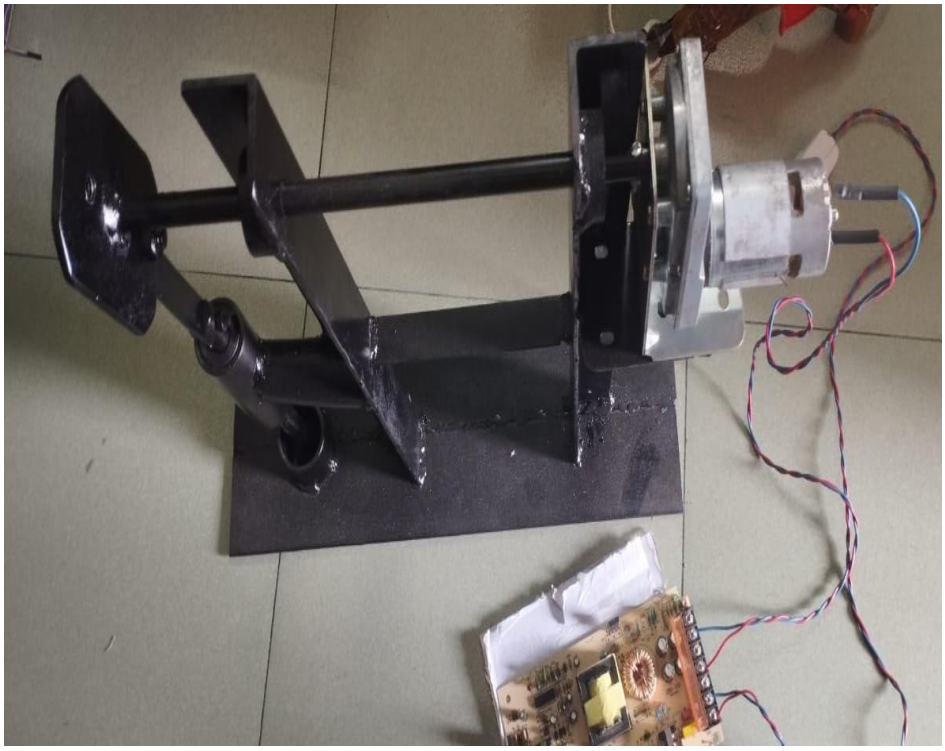


Figure 5.1: Picture of Automated Mashing Machine

We have provided DC 12 volt 10 amp power in this project. The motor we used is model 775. Motor rpm speed is 6070. Torque (g-cm) 725. Geared with it then motor speed 68 rpm, Torque (kg-cm) 20.

Material	**Weight**	**Mashing Time**
Rice	20 gm	2 Minute 20 Second
Potato	20 gm	3 Minute
Wheat	20 gm	2 Minute 25 Second

TABLE NO :01

Chapter 6
Discussion

6.1 Advantages

Automated mashing machines offer several advantages in various industries and applications due to their ability to automate and optimize the mashing process. Here are some key advantages:

Efficiency: These machines can significantly increase the efficiency of the mashing process by automating repetitive and labor-intensive tasks. They can work continuously and consistently, reducing the time and effort required compared to manual mashing.

Consistency: Automated mashing machines can deliver consistent results, ensuring uniformity in the final product. This is particularly important in industries like food processing, where product quality and taste need to meet specific standards.

Labor Savings: By automating the mashing process, businesses can reduce their labor costs. This is especially valuable in industries with high labor expenses, such as food production.

Reduced Physical Strain: These machines help reduce the physical strain on operators. They are designed to handle the repetitive tasks involved in mashing, which can be physically demanding when done manually.

Precision Control: Many of these machines come equipped with advanced control systems that allow for precise adjustment of parameters such as mashing time, speed, and pressure. This level of control can lead to optimized results.

Increased Productivity: With faster and more consistent processing, businesses can increase their overall productivity. This can lead to higher output and potentially increased profitability.

Versatility: Depending on the design and customization options, these machines can handle a wide range of materials and applications, making them versatile tools in various industries.

Hygiene and Safety: In industries like food processing and pharmaceuticals, motorized mashing machines can be designed with hygiene and safety in mind. Easy-to-clean surfaces and safety features reduce the risk of contamination and accidents.

Capacity: These machines can often handle larger volumes of materials compared to manual methods. This is particularly valuable in industries with high production demands.

Customization: Many machines are customizable to meet specific application requirements. This includes adjusting the size and capacity of the mashing chamber and modifying the spring force to suit different materials.

Data Logging and Monitoring: Some advanced machines come with data logging and monitoring capabilities, allowing operators to track and analyze the mashing process. This data can be valuable for quality control and process improvement.

Reduced Waste: By providing precise control over the mashing process, these machines can help reduce material waste and improve yield.

Product Quality: The consistent and controlled nature of motorized mashing can lead to higher product quality, which is essential in industries where quality standards are paramount.

Competitive Advantage: Adopting Automated mashing machines can give businesses a competitive edge by improving efficiency, product quality, and cost-effectiveness.

Scalability: These machines can be scaled up or down to accommodate different production volumes, making them suitable for both small businesses and large-scale industrial operations.

In summary, Automated mashing machines offer numerous advantages, including increased efficiency, consistency, labor savings, and the ability to meet high-quality standards. Their versatility and customization options make them valuable tools in a wide range of industries.

6.2 Cost

Equipments Name	Price(BDT)
Frame	3500
12V dc gear motor	2200
Bearing	300
Power supply (SMPS)	1200
Color	350
Total Cost	7550/=

Table 2: Cost Estimation

6.3 Limitations

Automated mashing machines are valuable tools for various industries, but they do have some limitations and considerations to keep in mind:

Material Compatibility: These machines are designed for specific materials and applications. Using them for materials they weren't designed for can result in inefficiency, damage to the machine, or poor quality results.

Maintenance Requirements: Like any machinery, motorized mashing machines require regular maintenance to ensure they function correctly. Neglecting maintenance can lead to breakdowns and increased operational costs.

Initial **cost:** The purchase and installation of a motorized & spring assisted mashing machine can represent a significant upfront investment. Smaller businesses or startups may find it challenging to afford these machines.

Space and Footprint: These machines can be relatively large, which means they require ample floor space in a facility. Space constraints can limit their feasibility for some businesses.

Noise and Vibration: Depending on the design and power of the motor, these machines can produce noise and vibrations. Adequate noise insulation and vibration dampening may be required in certain settings to ensure a comfortable working environment.

Energy Consumption: Motorized machines, especially those with powerful motors, can consume a considerable amount of energy. This can contribute to operational costs and environmental concerns, especially if the energy source is not efficient or sustainable.

Operator Training: Proper operation of these machines often requires trained personnel. Inadequate training can lead to suboptimal results, safety risks, or machine damage.

Limited Flexibility: Some machines may have limited flexibility in terms of adjusting the mashing process. Customization may be challenging, especially if the machine is designed for a specific purpose.

Product Quality and Consistency: While these machines are designed to improve consistency, achieving uniform product quality can still be challenging. Variability in material properties or operator error can affect the results.

Hygiene and Sanitation: In industries like food processing and pharmaceuticals, ensuring the cleanliness and sanitation of these machines can be labor-intensive. Disassembly and cleaning may be required between different batches or materials.

Size Constraints: In applications where space is limited, it may be challenging to install or operate larger mashing machines. Smaller, more compact alternatives may be needed.

Maintenance Downtime: Scheduled maintenance and unexpected breakdowns can lead to downtime, impacting production schedules and efficiency.

Environmental Impact: The materials and manufacturing processes used in these machines can have environmental impacts. Sustainability considerations are becoming increasingly important in equipment design and operation.

Regulatory Compliance: Depending on the industry and application, there may be specific regulations and standards that these machines must adhere to, adding complexity to their use.

To mitigate these limitations, it's essential for businesses to conduct a thorough evaluation of their specific needs, consider the costs and benefits, and ensure proper maintenance and training are in place to maximize the effectiveness of motorized spring assist mashing machines.

6.4 Application

Motorized spring assist mashing machines have a wide range of applications across various industries where the process of mashing or processing materials is required. These machines are designed to streamline and optimize the mashing process, making it more efficient and less labor-intensive. Here are some common applications:

Food Processing:

Potato Mashing: Mashing machines are often used in the food industry to mash potatoes for dishes like mashed potatoes or potato-based products.

Fruit and Vegetable Processing: These machines can also be used to mash fruits and vegetables for the production of sauces, purees, baby food, and fruit-based products.

Brewing and Distilling: In brewing and distilling, mashing machines are used to mash grains (e.g., barley, corn, wheat) to convert starches into fermentable sugars as part of the beer and spirits production process.

Pharmaceuticals:

Tablet Manufacturing: Mashing machines may be used to prepare active pharmaceutical ingredients (APIs) for tablet manufacturing.

Compounding: These machines can assist in the compounding of pharmaceutical ingredients to create custom medications or dosage forms.

Chemical Processing:

Chemical Reactions: Mashing machines can be employed in chemical industries to facilitate and control chemical reactions by breaking down and mixing various chemical components.

Polymers and Plastics: In the plastics industry, mashing machines can be used to process polymer materials.

Cosmetics:

Cream and Lotion Production: Mashing machines may be utilized in the cosmetics industry to blend and mix ingredients for the production of creams, lotions, and cosmetics.

Agriculture:

Animal Feed Production: In animal feed manufacturing, these machines can be used to process grains and ingredients into animal feed.

Materials Testing:

Materials Characterization: Mashing machines can be used in materials testing laboratories to evaluate the mechanical properties of materials by subjecting them to controlled forces and deformations.

Environmental Sciences:

Soil and Sediment Analysis: These machines can be used to prepare soil and sediment samples for laboratory analysis.

Biotechnology:

Cell Disruption: In biotechnology, mashing machines can be employed to disrupt cells and release cellular contents for further analysis or extraction of bimolecular.

Construction Materials:

Concrete Testing: Mashing machines may be used to test the compressive strength of concrete samples. The specific design and features of a motorized spring assist mashing machine can be tailored to the needs of the particular industry or application. These machines play a crucial role in ensuring consistency, quality, and efficiency in various manufacturing and processing processes across different sectors.

Chapter 7

Conclusion

7.1 Conclusion

Our mashing machine can do a lot of mashing in a short time. It is very easy to use. Anyone can operate this machine. As the hole is small, the hands will not go inside it and the work of mashing can be done safely. Since more mashing can be done in a short time, we can say that this device costs less.Integration with advanced control systems, such as AI and machine learning, can optimize the mashing process by adapting to changing materials and conditions. Smart sensors and real-time data analysis can help in adjusting parameters for the best results.

Developing more energy-efficient motors and mechanisms can reduce the environmental impact of mashing machines. Additionally, energy recovery systems could be implemented to capture and reuse energy during the mashing process.Innovations in design and technology can help minimize material waste during the mashing process. This could include more precise cutting and sizing of materials to reduce scrap.Machines that can easily adapt to different materials and mashing requirements will be highly sought after. Modular designs and quick-change tooling systems can facilitate this.Advancements in materials science can lead to the development of more durable, corrosion-resistant, and food-grade materials for constructing mashing machines.IoT Integration: Internet of Things (IoT) technology can be integrated into these machines for remote monitoring, predictive maintenance, and data analytics to improve performance and reduce downtime.Ongoing work in safety features and automation can lead to even safer operation. For example, collision detection systems can help prevent accidents, and predictive maintenance can reduce unexpected breakdowns.Manufacturers will likely prioritize sustainability by using eco-friendly materials, optimizing energy usage, and reducing the carbon footprint of production and operation.Customization and User-Friendly Interfaces: Future machines may have intuitive interfaces that allow operators to easily customize the mashing process to achieve the desired results. This could include touchscreens, augmented reality (AR) guides, or even voice-activated controls.

Integration with Industry 4.0: As industries embrace Industry 4.0 principles, mashing machines may become integral parts of interconnected smart factories. They can communicate with other equipment, share data, and contribute to a more efficient and responsive manufacturing process.Research into improving the quality and consistency of mashed products will continue. This involves refining the mashing process to achieve the desired texture, flavor, and nutritional content.Quieter and smoother operation can improve the working environment and extend the lifespan of the machine.In summary, the future of motorized spring assist mashing machines involves a combination of technological advancements, sustainability efforts, and a focus on improving product quality and user experience. As industries evolve and demand higher efficiency and quality standards, manufacturers will continue to innovate in response to these needs.

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