Project Proposal

<u>Voice-Controlled Smart Drawer System</u>

Team: **Atom-230294**

Team Members:

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Objective:

The main objective of our project is to enhance the convenience, efficiency, safety, and comfort of daily life by integrating technology and automation into various aspects of a home. We achieve this by creating a voice-based smart drawer system that opens and closes drawers using voice commands and hand gestures according to the objects present inside them. This can be a convenient and innovative addition to your home, providing hands-free access to drawer contents and reducing the time it takes to search for things we need.

Beneficiaries:

The primary beneficiaries of our voice-controlled smart drawer system are homeowners seeking to enhance their daily lives with seamless automation and convenience. Busy individuals, families, and anyone looking to simplify their daily routines will find our technology invaluable. Additionally, individuals with mobility challenges or disabilities will experience newfound independence and ease in accessing drawer contents. Our project strives to improve the quality of life for all, making home organization effortless and enjoyable.

Value Of Results:

There are many potential values and benefits for our project idea some of them are listed below

1. Convenience: Users can access drawer contents without physically opening them, which can save time and effort in everyday tasks.

2. Efficiency: The system can help users locate items quickly, increasing overall productivity and reducing frustration associated with searching for objects.

3. Accessibility: People with mobility challenges or disabilities can gain increased independence and autonomy in accessing drawer contents.

4. Customization: Depending on the system's features, users may be able to customize voice commands and gestures, tailoring the system to their specific needs.

Background:

In an era defined by rapid technological advancements and the ever-increasing demand for convenience and efficiency, there is a growing need to innovate and integrate automation seamlessly into our daily lives. The traditional act of going through drawers and cupboards to find essential items can be time-consuming and frustrating, especially in today's fast-paced modern world. This inconvenience is further amplified for individuals with mobility challenges or disabilities. By using the power of voice recognition and gesture control, we seek to create a voice-controlled smart drawer system.

The project idea was inspired by our desire to enhance the efficiency of searching through drawers to find the object that we need by automating the whole process itself and making it more efficient. During research, we also sought its effectiveness for the disabled and how it would empower them.

Through this project, we aspire to create a home automation device that makes our everyday lives more efficient and comfortable while also creating something that helps a lot of needy people.

Statement Of Problem:

The problem at hand is the inefficiency and inconvenience associated with traditional methods of accessing and organizing items within home drawers and cupboards. This challenge arises from the manual nature of these tasks, which can be tiring for busy schedules and those with mobility limitations. As highlighted in the background section, the need for a more efficient and accessible solution is evident, given the rapid pace of technological advancement and the desire for improved quality of life.

Our project aims to fulfill this by creating a smart drawer system that takes our voice as input and automatically opens the drawer with the item asked for and then closes itself.

Research:

In our quest to redefine the way we interact with drawers, we have embarked on an ambitious journey that merges home automation, voice control, and gesture recognition technologies. We combine the precision of stepper motors with the convenience of electromagnets, and we have created a reliable system capable of delivering unparalleled accuracy and control.

We achieve the key features by using these solutions:

1. Innovative Drawer System Integration:

   - Integration of precision stepper motors and electromagnets for drawer control.

   - The combination promises unparalleled accuracy and control in drawer movements.

2. Voice Control Integration:

   - Utilizing Espeech recognizer for voice input and speech recognition.

   - We use rasa as a machine learning software to understand the context of the speech and identify the drawer to open based on the speech.

   - We use pyttsx3 as a output tool that sends the rasa output to arduino.

3. Gesture Recognition and Hand Gesture Detection:

- Implementation of hand gesture recognition powered by OpenCV and MediaPipe.

- Enhancing user convenience and accessibility through intuitive hand movements.

4. 3D Printing for Customization:

- Utilizing 3D printing technology for drawer fabrication and system layout design.

- Precision and customization advantages for tailored drawer dimensions and functionalities.

5. Technology Integration:

- Meticulous integration of components including drawer sliders, housing, electronics, sensors, and voice control systems.

- Ensuring a cohesive and functional system.

6. Summary of Technologies:

- Fusion of Voice recognition (Rasa), natural language processing (NLTK), stepper motors, electromagnets, and computer vision (OpenCV).

- Refined automation, accessibility, and efficiency for home organization.

7. Unique Features:

- User-centric approach with intuitive voice control for convenience and accessibility.

- Efficiency and responsiveness with electromagnets for quick drawer access.

- Adaptability through hand gesture recognition, catering to diverse user preferences.

8. Impact and Applications:

- Revolutionizing home organization.

- Potential applications in industrial automation and various domains.

- A system designed for users of all age groups, enhancing daily living.

9. Future Potential:

- Setting new standards in home automation.

- Paving the way for further innovation and development in smart home technology.

- Enhancing the quality of life through cutting-edge automation and accessibility.

In summary, our project is a fusion of various technologies to create an innovative smart drawer system. Voice recognition powered by Rasa and natural language processing through NLTK facilitates seamless user interaction. Stepper motors and electromagnets are employed to push the drawer forward, responding to voice commands, while OpenCV's computer vision capabilities detect and interpret hand gestures, adding an extra layer of convenience. In addition, 3D printing is utilized to fabricate customized drawers and the physical layout of the system.

Our project distinguishes itself by harnessing a trifecta of innovations to elevate user experience and efficiency. Firstly, our voice control model, powered by Rasa, ensures intuitive and effortless interactions, enhancing convenience and accessibility. Secondly, we've incorporated electromagnets for drawer operation, significantly improving efficiency and responsiveness, ensuring quick access to drawer contents. Lastly, the integration of hand gestures via OpenCV adds an extra layer of versatility, making our smart drawer system adaptable to various user preferences and needs. This multifaceted approach represents a leap forward in smart home automation, offering an unparalleled blend of user-centric features.

Technical Report:

a)Description of concepts and theories-

1. Stepper motor -: Firstly, the utilization of stepper motors aligns with the theory of precision control. Stepper motors offer highly accurate and

incremental movements, ensuring the drawer can be opened and closed with utmost precision, making them an ideal choice for automation.

2. Arduino -: The application of Arduino, based on principles of embedded systems and microcontroller programming, facilitates the seamless integration of hardware and software, enabling users to customize and control the smart drawer effortlessly.

3. Electromagnets -: Electromagnets are employed to securely hold and release the drawer, providing a robust and reliable locking mechanism. The principle of electromagnetic induction governs the conversion of electrical energy into magnetic force, allowing for the efficient operation of the drawer's locking mechanism

4. Rasa: Rasa is machine learning software that allows our device to recognize objects and choose which drawer to open and sends data back to our motor which opens the drawer for us.

5. Espeech and pyttsx: These allow us to perform the input and output operations for rasa where espeech recognizer converts voice signals to input for rasa and pyttsx converts rasa data to send to ardunio.

START-

Define Project Scope and Objectives

- Identify Key Goals and Objectives
- Specify Features and Functionalities
- Determine Target Audience

Research and Planning

- Investigate Existing Technologies
- Gather Information on Technical Components
- Gather Information on Electronic Components

Component Selection and Procurement

- ❖ Select Mechanical Components
    - Stepper Motors
    - Electromagnetic Mechanisms
    - Drawer Slides

- ❖ Select Electronic Components
  - Microcontrollers (e.g., Arduino, Raspberry Pi)
  - Sensors (e.g., for object detection)
  - Speech Recognition Hardware (e.g., microphones)
  - Computer Vision Hardware (e.g., cameras)

Mechanical Design and Assembly

- ❖ Design Mechanical System
  - Design Drawer Configurations
  - Implement Stepper Motor Setup
  - Integrate Electromagnetic Mechanisms

- ❖ Assemble Mechanical Components

Electronic System Development

- ❖ Develop Control Software
  - Program Microcontrollers
  - Implement Logic for Drawer Movements
  - Integrate Object Detection Algorithms

- ❖ Develop Voice Control System
  - Configure espeech recognizer package for Speech Input and recognition
  - Using rasa for machine learning and using the speech signal to identify the drawer
  - Utilize pyttsx3 for Speech Output
- ❖ Develop Gesture Recognition System
  - Implement OpenCV for Computer Vision
  - Incorporate MediaPipe for Gesture Recognition

Integration of Mechanical and Electronic Systems

- Combine Mechanical and Electronic Components
- Test Drawer Movements
- Ensure Integration of Voice and Gesture Control

Testing and Debugging

❖ <u>Conduct Comprehensive Testing</u>
- Test Voice Commands and Recognition
- Evaluate Gesture Recognition Accuracy
- Ensure Drawer Movements are Accurate and Reliable
- Test Sensors and Object Detection

User Interface Development

- Create User Interface (App or Voice Assistant Integration)
- Ensure User-Friendly Controls
- Test User Interface

Final Testing

- Test the Entire System as a Whole
- Gather User Feedback
- Refine and Debug as Necessary

Documentation and User Manuals

- Create User Manuals and Guides
- Document System Architecture
- Provide Troubleshooting Information

Final Implementation

- Install the System in the Target Environment
- Provide User Training (if needed)
- Ensure Proper Functionality

END

TechStack :

- Python 3.8
- Rasa 2.8.13
- Espeech Recognition package
- Pyttsx3
- Opencv
- Mediapipe

Components:

1. Stepper motor
2. Threaded Rods
3. Electromagnet
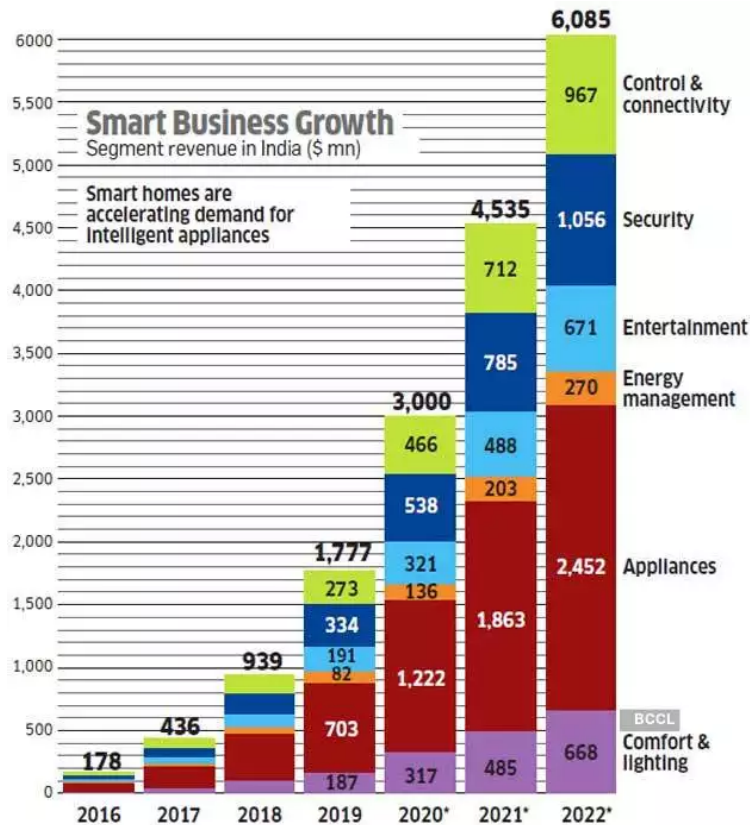4. Arduino

Market Report:

We think there is a substantial market for innovative home automation solutions, including smart drawer systems. This market is driven by a variety of factors, including the increasing adoption of smart home technology, the desire for convenience, and the growing awareness of accessibility needs. Thus we think with proper investment and innovation this will fair very well against traditional counterparts.

Target Customers:

- Students and Educational Institutes: Students, both at the college and high school levels, can benefit from the efficiency this system offers in accessing study materials, stationery, and personal items. Educational institutions can also consider implementing such systems in various places to make it more convenient for storing important stuff.
- Homeowners: The primary customer group for this product includes homeowners seeking to enhance their living spaces with automation and convenience. They will pay for this solution to make their daily routines more efficient and enjoyable. This also includes individuals with busy schedules looking to improve their daily tasks and increase time efficiency.
- Individuals with Disabilities: People with mobility challenges or disabilities represent a significant market segment. They will be willing to invest in this technology to gain independence and ease in accessing drawer contents.

People will pay for the voice-controlled smart drawer system due to its ability to provide unparalleled convenience, accessibility, and efficiency in daily life. Customers, including homeowners, families, individuals with disabilities, and students, will be motivated by the system's capacity to save time, enhance accessibility, improve organization, and offer a modern, tech-savvy lifestyle. This investment is driven by a desire for greater ease in daily routines, reduced frustration, increased independence, and a taste of cutting-edge technology, making it an attractive and worthwhile addition to their homes.

According to this study published by The Economic Times, we can see how much the market share for smart home appliances has increased and how this trend will continue to rise as more and more products rise. This shows that there is a lot of potential that is still untouched and our product will fare very well in this market in the long run.

Smart Business Growth
Segment revenue in India ($ mn)

Smart homes are accelerating demand for Intelligent appliances

-Source: The Economic Times

Year	2016	2017	2018	2019	2020*	2021*	2022*	Category
Total	178	436	939	1,777	3,000	4,535	6,085	
Control & connectivity				273	466	712	967	Control & connectivity
Security				334	538	785	1,056	Security
Entertainment				191	488		671	Entertainment
Energy management				82	203	270		Energy management
Appliances			703	1,222	1,863	2,452		Appliances
					321	136		
Comfort & lighting			187	317	485	668		Comfort & lighting

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