SEMI-HUMANOID OFFICE ASSISTANT

A NEW GENERATION OFFICE ASSISTANT

An Interdisciplinary Project By:

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Problem statement:

In 21st century, many people are working for huge MNCs. We also have improved our literacy rates; hence every individual deserves a better and high paying job. But in every company, there is a need of attendants in order to help other employees, viz, transferring files from one cabin to another, cleaning the premises etc. In many companies, such people are under-payed, hence even such people deserve for a better job that would pay them high, but if we the companies hire them for the other posts, there should be substitute for the attenders.

If we have other humans as attenders, we might be distracting from the motto of replacing humans who carry out such under-payed job to a privileged post. Hence, if we aim to replace humans from such jobs, machines can be at our rescue. We can have intelligent machines that could carry out these tasks, without even need to pay them. We can have office assistants who could transfer files, clean the premises, and even prepare and serve tea and coffee to the employees.

Literature Survey:

There are such assistant bots developed by huge companies like Honda, Huawei, etc. We can also consider Sophia as one great advancements in robotics and Artificial Intelligence. But Sophia is a generic bot. i.e. it can perform almost all tasks, but in offices using such bots as assistants just to pass the files, serve beverages would cost huge investment to the companies.

Many specific task bots are also developed, but they cost not less than at least Rs. 10,00,000/-, but we are trying to make a task specific bot within Rs. 1,00,000/-.

Why is the particular topic is chosen?

The main reason of choosing this particular topic is to reduce the stress on humans, as delivering important files withing a stipulated time adds stress and it's a tough job to carry out, since the companies are huge and humans would get tired easily. Also, in the company perspective, hiring human resource for such tasks is huge investment.

Semi-Humanoid Assistant reduces human stress and also may save a lot of money to the company, because unlike the present solutions, the bot would never get tired and would also work faster than humans, bot would not experience the emotional stress like humans.

Scope of study:

The project covers the entire domain of Software, Hardware and Mechanical Engineering.

- Software domain includes the Machine Learning, Software Development, Communication Protocols etc.
- Hardware Domain includes, Electronics, Circuit Designing, PCB designing and fabricating, power supply part of the machine etc.
- Mechanical Engineering Domain includes designing and fabricating the skeleton of the bot, adding robustness to the structure, planning for the appropriate drive mechanism etc.

Objective and Scope of study:

Objective:

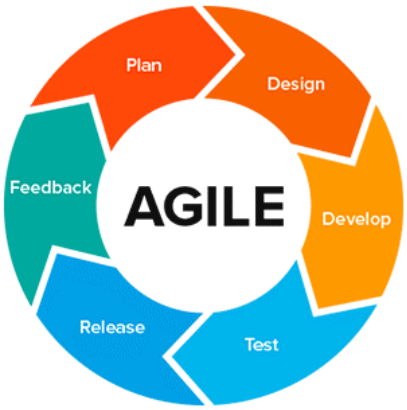
- Deliver Files and other documents within an office campus
- Self-charge, so that it never runs out of charge
- Reduce the time of delivering the files and documents
- Can operate elevators as humans do
- Can interact with humans and answer some frequently asked queries

Scope of Study:

- Machine Learning
- Speech Processing
- Natural Language Processing
- Mechanical aspects of the bot
- Driving system of the bot
- Robotic Arm Programming

Methodology:

Methodology followed to accomplish the project is **Agile.**



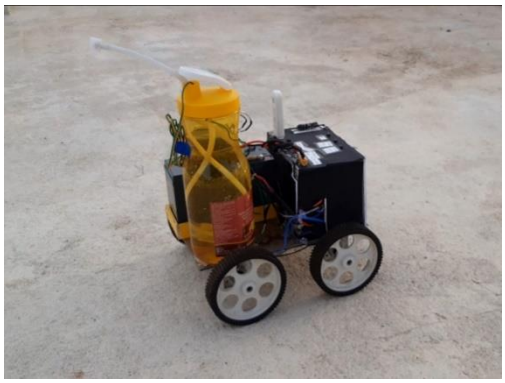
❖ Plan or route-map to accomplish the project:

- **Phase – I (September, 2020 to December, 2020):**
  - Develop a room mapping system and save the map
  - Using ROS and SLAM to navigate the bot as per the map
  - Develop a system to recognize the numbers
  - Outer Body Designing
  - Precise calculations of load, torque applied by each wheel according to the direction of motion, vector calculations
  - A prototype that demonstrates the above-mentioned features

- **Phase – II (January, 2021 to May, 2021):**
  - Display configuration
  - Motion controlling of the bot
  - Robotic Arm Controlling
  - Natural Language Processing
  - Circuit Designing
  - Robotic Arm Designing
    - Kinematics
    - Dynamics
    - COG Calculation
    - Torque Calculation of Motors
  - Fabrication & Assembly of Robotic Arm
  - Fabrication & Assembly of Body
  - Testing and Submission

❖ Progress so far:

There was a previous version made, serving a different application i.e. of sanitization. This prototype served as the base for developing Semi-Humanoid Office Assistant. The Sanitizing Bot was an inspiration to build a Humanoid version with slightly different application.



The **Sanitization Bot** was built around an ESP-32 microcontroller, and was controlled over the internet through a Server, that setup on Google Cloud Platform. The knowledge of setting up a server and understanding about Networking, would help us in our Humanoid Bot Project. The Sanitizing Bot was controlled from across the world. A prototype was also made of the same. The YouTube video link for the Sanitization Bot Project is attached: https://sdmcet.ac.in/news/innovation-by-sdmcet-students/

❖ Progress of in Semi-Humanoid Office Assistant:

The progress made in Semi-Humanoid Office Assistant are:

- A* path finding algorithm
- ROS Navigation
- Study of LIDAR systems
- Study of Robotic Manipulators, End-effectors, Joints
- Rough Outline of the Outer Body of the Bot
- Wheel alignment study

A* Path Finding Algorithm Visualization

The design and fabrication of the Semi-Humanoid Assistant gets divided mainly into two domains namely Mechanical Domain and Electronics & Software Domain.

Mechanical domain:

As the bot needs to perform well in the real-world scenarios, it should have a robust structure.

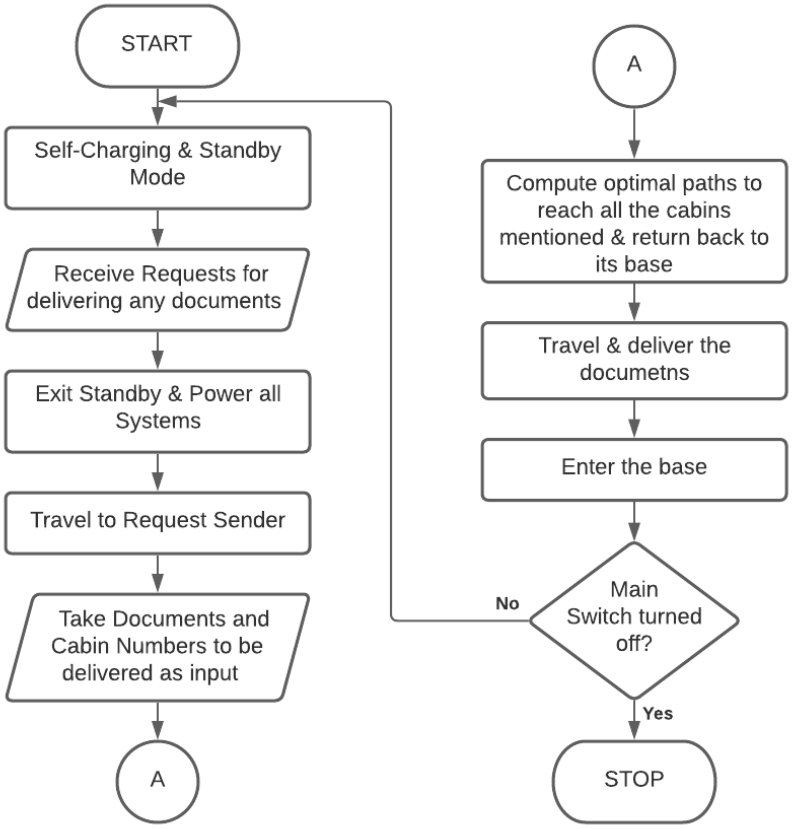
- **Features:**
  - ✓ A robust Driving System
  - ✓ Robotic Arm for operating elevator buttons
  - ✓ Mechanism for delivering the files and documents safely
  - ✓ Direction Changing without using Ackerman's Steering Mechanism

Electronics and software domain:

The bot will be embedded with AI. The AI is achieved by embedding the following features

- ✓ Room Mapping
- ✓ Number Recognition
- ✓ Number Recognition using Deep Learning
- ✓ Natural Language Processing
- ✓ Design of a web interface having controls of the bot
- ✓ Motion control of the bot
- ✓ Robotic Arm Controlling
- ✓ Self-charging system

❖ Flowchart:



❖ Working:

The entire system will have a web interface, from where the bot can be initialized and can be sent a request to collect the files. The bot, by default, will be in its charging station on standby mode. As the bot receives the request, it processes the request and turns itself on and exits the standby mode. The bot comes out of the charging station and travels to the cabin from where the request was raised.

In that particular cabin, the bot can be loaded with files and also the cabin number where it should pass those documents. The bot, later visits those cabins and delivers the stuffs. Bot knocks door of each cabin and informs about the document to be collected. The bot is also capable to use elevators as humans do.

After the bot successfully delivers the documents, the bot automatically travels to its charging station and connects the charger, enters into the standby mode. The standby mode means, the bot is in sleep, there will be no power to its motors, display, speakers, etc., only power will be on for processing the external requests after which, the bot can exit the standby mode and begin its work.

Hardware and software to be used:

- **Hardware:**
  - ✓ LIDAR
  - ✓ USB Cam
  - ✓ Raspberry Pi 4
  - ✓ Stepper Motors & Drivers
  - ✓ DC Motor & Drivers
  - ✓ Display
  - ✓ Microcontroller
  - ✓ Omni Wheels
  - ✓ Li–Ion battery
  - ✓ Li-Po battery
  - ✓ M S Sheets
  - ✓ Hollow & Solid M S Rods
  - ✓ Motor Clamps
  - ✓ L Channel
  - ✓ Square Channel
  - ✓ M S Strips
  - ✓ PLA & ABS 3D Printing Filaments
  - ✓ 3D Printer
  - ✓ Circuit Fabricating Materials
- **Software & Tools:**
  - ✓ Ubuntu 20.04 Operating System
  - ✓ ROS – Robot Operating System
  - ✓ Turtlesim & Turtelsim3
  - ✓ Solidworks
  - ✓ Matlab
  - ✓ Machine learning
  - ✓ Web interface
  - ✓ Server

What Contribution would the project make?

Semi-Humanoid Assistant, reduces human stress who are being appointed as attenders in a company, this bot also saves money of the companies by avoiding the investment on human resources for such works, in-fact, allowing human resources to be utilized in a more efficient use. This project also, contributes to the Atmanirbhar Bharat Ideology of Prime Minister Shri Narendra Modi. Hence, this project is expected to add to the technology.

Conclusion:

Semi-Humanoid Assistant adds to the present technology, promotes the ideology of Atmanirbhar Bharat. This bot can bring reforms in the economic development of the country, helps the companies to reform their financial status. This bot also reduces the human stress, and also allows humans to extend their limits and improve their potentials, and companies can use their skills in a more efficient way and improve the status of the company.

References:

- ✓ To Calculate the battery run time: https://www.youtube.com/watch?v=FSW0fIaOkPE&ab_channel=MegaPowerServices
- ✓ To Calculate the torque of the motor: https://www.youtube.com/watch?v=b-PYPJ6SWJM&t=317s&ab_channel=EVTutor
- ✓ GCP Guide