Voice Controlled Mecanum-Based Forklift (VOCMEF)

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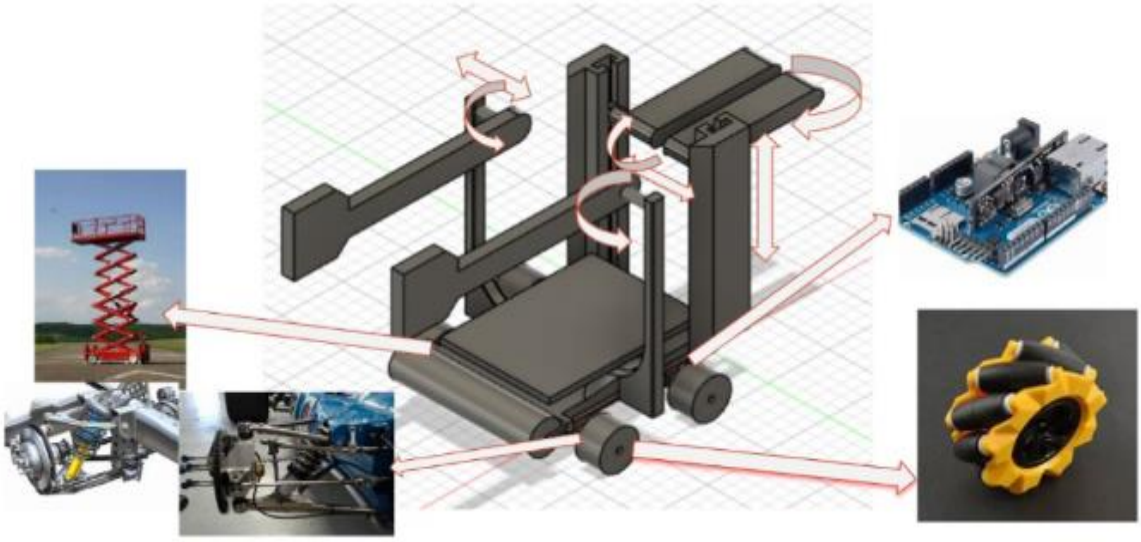
Abstract -

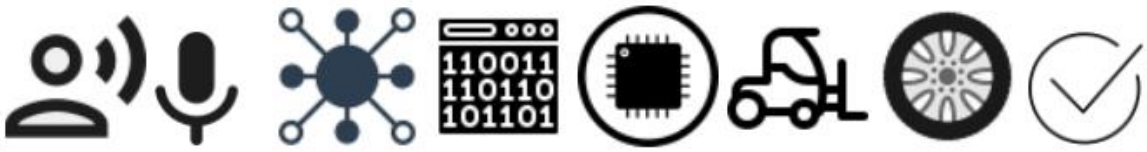
The currently available forklifts in the industry have a number of limitations . Various accidents (mainly involving goods toppling or forklift toppling) occur everyday where forklifts fail to accomplish their task. This leads to bulk losses, financially as well as materially. Many cases result in human injury as well. In this era of industrialization, forklifts, which are the basis of transportation inside huge warehouses, should be mechanically and technologically perfect. The Voice Controlled Mecanum based forklift (VOCMEF) is a modified version of the current forklift, built to counter the drawbacks of the existing forklifts in the industry .



The present forklift vs VOCMEF , a brief summary of structural features and advantages –

Forklifts used by the industry in the present date encounter a huge number of disadvantages due to their shape and build. To counter these problems, the VOCMEF design includes **extended Robot like arms , rollers** and a structure similar to original forklift but with a **belt drive** . This mechanism allows

us to grab/put the objects smoothly as well as shift the goods to the **center** of the VOCMEF , hence increasing stability and **reducing forward toppling** of goods . The Roller optimizes the process of lifting up **boxes** , since it keeps the boxes in lying position . The side rods from the robot arm even prevent **sideways toppling** problem . Furthermore , the VOCMEF is equipped with **wishbone suspension** for additional stability , and the center plate can be moved vertically using X-lifters (**scissor mechanism**) to provide additional support while placing the objects . Being equipped with **Mecanum wheels** allows it to **maneuver in tight spaces** thus being fit for industrial warehouses . Data Encoding using **Hamming Code** allows scope for automatic **error correction** in the received signals . And lastly , the **Voice control** implemented using **deep learning** improves the **safety** of the workers , creates opportunities for **off site working** , as well as creates **more space** on the machine to carry goods . Thus , the Electronic and Mechanical design of the **VOCMEF** is such that it is the optimal replacement of present forklift models in the industry .



The Mechanism , a brief summary of the mechatronic modelling –

A voice input device like a microphone or **mobile phone** takes voice command from the user/worker as input. Then the voice signal is **sampled** . Then short time fourier transform **(STFT)** of the signal is performed , and then the resultant is fed to a **deep learning model** , which consists of a 2D Convolutional Neural Network **(2D CNN)** model . This model is trained with 8000 audio samples having voice commands, and works with an average accuracy of 85% which is quite capable of being used industrially as the commands are one-word. The detected command is converted into a **numeric code** for transmission , and further converted to **Hamming code** for error correction to account for transmission errors . The command is then sent to the **microcontroller** installed on the forklift via some network like Wi-Fi, Bluetooth, or some Wide Area Network. We used Arduino Uno ATmega328p along with **Bluetooth** for communication . The signal is decoded by the driver code of Arduino then operates the **motors** accordingly via a motor driver , which in turn operates the **mecanum wheels** and the **belts/arms** in the direction suitable for the required overall motion of the VOCMEF .

Files included in the github repository –

ML model .ipynb file

ML model weights file .h5

CAD Model .f3d file

Arduino code .ino file

Proteus Circuit Simulation in .zip file

.mp4 file showing demonstration