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Voice Enabled Robotic cum Prosthetic Arm for Disabled People

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Abstract: ***Thriving the use of prevailing technologies in a planned & statistical order so as to achieve something we could make use of, benefiting especially abled common people as well as upcoming vocal based era of robotics, we came up with Voice Enabled prosthetic / robotic Arm. This project was earlier based on providing well-functioning cheap artificial limb, until we explored wide aspects of uses of this technical piece while working on it. Project may be categorized as IoT, based on tech tools used in building it. Working on Natural Language Processing (NLP) this project is able to understand up to 100 daily use commands at its lowest level.***

Keywords: IoT; robotics; NLP; voice control; robotic arm; prosthetic arm

I. INTRODUCTION

The fact we may not deny is that presence or absence of Technology affect minds a lot. Around 30% people suffering from limb loss experience depression or anxiety. Looking at statistics according to Access Prosthetics around 2 million people in US are suffering from limb loss and this number is expected to double up till 2050. Also each year 1, 85,000 people face amputation.

Designing a technology that emphasized on solving problems of especially abled have been always a challenge, so as to prove to be as original as a real human body part. If we talk about prosthetics for these limbs then it costs so much that's not affordable to common person. If we talk about leading companies in field of prosthetics Open Bionics' basic and cheapest hero arm costs around ₹14,000/- and above , Mobius Bionics' Luke arm is available for sale only in US and also it costs heavy.

Another big reason to think upon "voice enabled robotic arm and gadgets" is the upcoming era of automation where we expect that most of the work will be done on voice commands to technically advanced robots. We are already in the world where gadgets like Alexa, Echo etc. have reached doorsteps of common people and they do respond to voice commands given to them. So it's easy to predict that soon we will be commanding robots in our daily life. Moreover if technology like robotics is brought to cheaper levels that we have tried, might result in providing more innovations and wonderful uses of them. Since there are endless number of companies working on robotics currently, we can expect that future we discussed is near. Companies like MITSUBISHI, KAWASAKI, and FANUC etc. are working tremendous in field of robotics and automation.

What we observed was that there was no technology that costed less and feasible to common people in all terms. Hence we developed a design of a *Prosthetic arm that would work on verbal commands provided* through android application developed specially for operating this arm. Since android device is available to almost everyone hence it may not cost much to download and use an app. This way cost of providing commands through application installed on phone became much cheaper than those with nervous sensors which operate on glitch of nerves which already have some demerits. In short in order to use this robotic arm one has to just install an application on phone, connect it with Bluetooth and start providing vocal commands like "hand close", "hand pick", "hand best of luck" etc. To build an effective prosthetic high-performance microchip from ATMEL ATmega328P was chosen. Its 8-bit AVR RISC-based microcontroller with 32kb program memory. This chip is enough to control programs we fed and operate each component strictly. After microchip we moved on to other hardware tools & components we needed like circuit board, Bluetooth module (small and compatible), servos (high power), circuit connectors, batteries, 3-d printed skeletal structure for arm, smart phone.

II. METHODOLOGY

We propose VCPH that works on a concept of sending EM signals converted from vocal waves through a smartphone. Which means that a user has to speak near his smartphone after operating android application which connects smartphones to microcontroller. The smartphones convert these voice signals to EM signals that transmits in air to the Bluetooth/Wi-Fi shield which receive the signals and encode it to analog signals. After encoding those, Bluetooth/Wi-Fi shield transfer signals to MC. MC from there identifies the signal and rotates the servos according to code fed to it through Arduino IDE.

Servos are connected to a wire which joins 5 fingers of prosthetic hand. When servo pulls any of the wire then the finger is bent and when servo release wire then it regains its open position. This regain of open position takes place due to rubber piece attached to backside of finger which provides finger elasticity.

III. MODELING AND ANALYSIS

A. *Stepwise Working*

1) User opens his/her smart phone and runs the application provided for connecting VCPH with MC via Bluetooth or Wi-Fi.
2) User then connects VCPH's Bluetooth module with smartphone, usually named HC-05.
3) User opts for vocal commands in the application
4) Then user sends voice commands using Google Voice API which supports NLP
5) EM signals converted via smart phone are transmitted and then received by HC-05 wirelessly.
6) HC-05 after receiving this signals sends them to MC
7) Certain codes are fed to MC according to which MC works on commands given to it via HC-05.
8) After finding the relevant commands MC transmits signals to servo driver.
9) Servo driver is further connected to 5 servos which are connected to 5 fingers of model.
10) According to commands sent to servo driver further sent to servos, movement of fingers take place.
11) If servos are turned then fingers are bent otherwise remain in open position.
12) After completing commands, hand opens up again because servos reach their original position and rubber strings attached at the back of fingers to provide it elasticity.

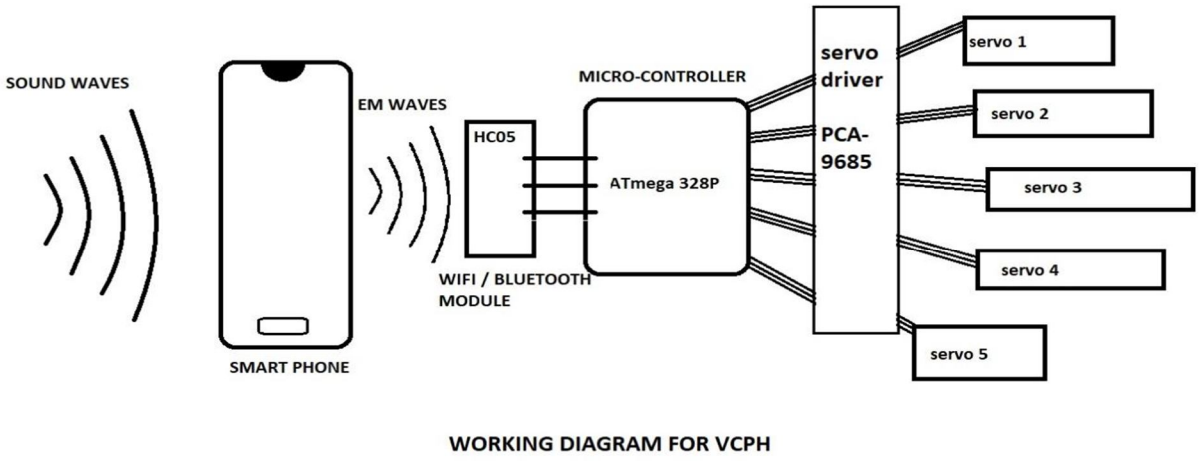

Figure 1: Working Model Diagram

After reading and analyzing the code for VCPH we found that code is totally based on 'if' statements, hence on the basis of number of commands designed for VCPH in IDE.
Hence, we can say that space complexity of model can be calculated as O (N).

IV. RESULTS AND DISCUSSION

After reading and analyzing the highly cost effective, reduces costs to at least 13 times. Since A myoelectric **prosthetic** for partial loss of a hand **cost ₹1, 32,640** whereas VCPH will cost a maximum of ₹6,000 to ₹7,000 only. Protection from muscle tampering and nervous tissue damage, since current prosthetic arms cause both damages due to continuous and unnecessary movements, which is impossible in VCPH because it's controlled by vocal commands only. A great helping hand in chores and other heavy duty tasks providing ease of handling jobs. Helpful to aged and weak people too, due to its great applications.

V. CONCLUSION

This design of robotic hand gives an ease of handling normal and daily jobs. In case it is implemented then it holds the potential of helping number of people in near future. Since smartphones have become part of human lives then it's the biggest advantage of this project since it's based on smartphone applications.

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We have further planned to bring out more and best results for this project by adding up more flexibility by more servos or motors to provide almost real hand rotations.

For advanced level we have planned and made a theoretical approach to use MACHINE LEARNING & ARTIFICIAL INTELLIGENCE in VCRA. By using ML & AI we tend to make this hand perceive and identify different motions and gestures from environment, watching people and creating commands by itself.

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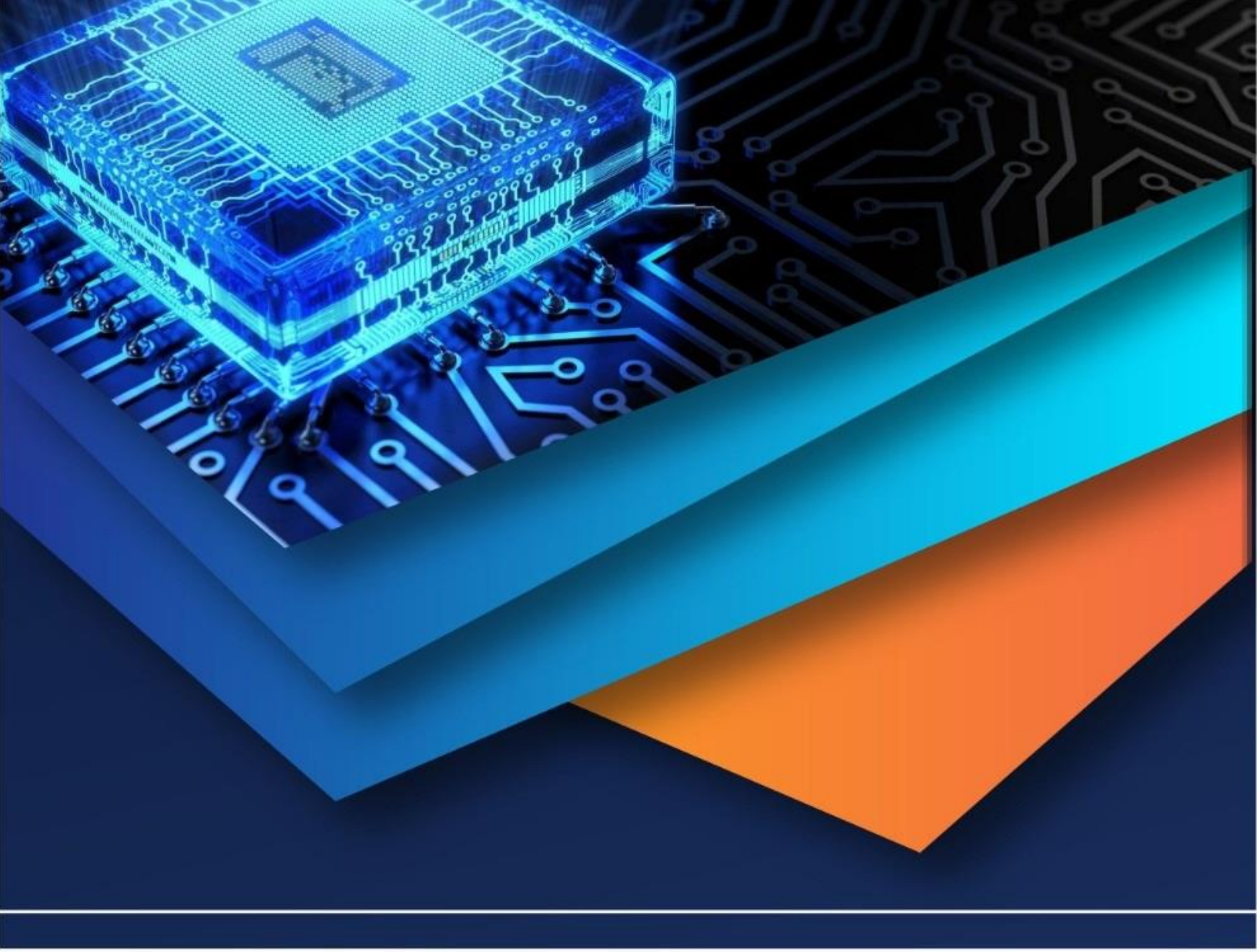

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