Command Control Robot on Field Programmable Gate Array

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Introduction:

Robots can be operated by an internal control system or by an external control device. The phrase "mobile robot" refers to an automatic operation that can perform duties anywhere and is made up of a platform that is moved by locomotive components. Making a robot go from one place to another without hitting any obstacles is a key challenge in robotics. Either path planning or navigation issues can be observed in this. Therefore, a robot may navigate the world using a variety of navigational techniques. Typical industrial robots are built to interact with their surroundings and operate objects. In this project, voice instructions are used to operate the robot. Using a smartphone application, voice instructions are processed. The recognized command is transformed into a format that the robot can understand.

All now in use automated machines, such as vacuum cleaners and lawn mowers, are managed by people. Such tasks require human assistance. Additionally, there are certain automated devices like robots that employ microcontrollers like Arduino, NodeMCU, etc. When they get responses from several sensors at once, it becomes challenging to control the robots. The robot can only be operated within a certain area by utilizing the Bluetooth module, thus a WIFI module and FPGA are utilized to get around these issues in real-time settings.

Survey:

In the paper, the examination of data transfer from the source to the API in a wireless environment is well detailed. The Mac layer was created using the VHDL programming language. This perfectly describes how data is sent across levels. It has been thoroughly described how the Mac layer works. Blocks with specialized purposes for preserving the transmission's flow include control blocks, probe blocks, authenticate blocks, etc.[1]

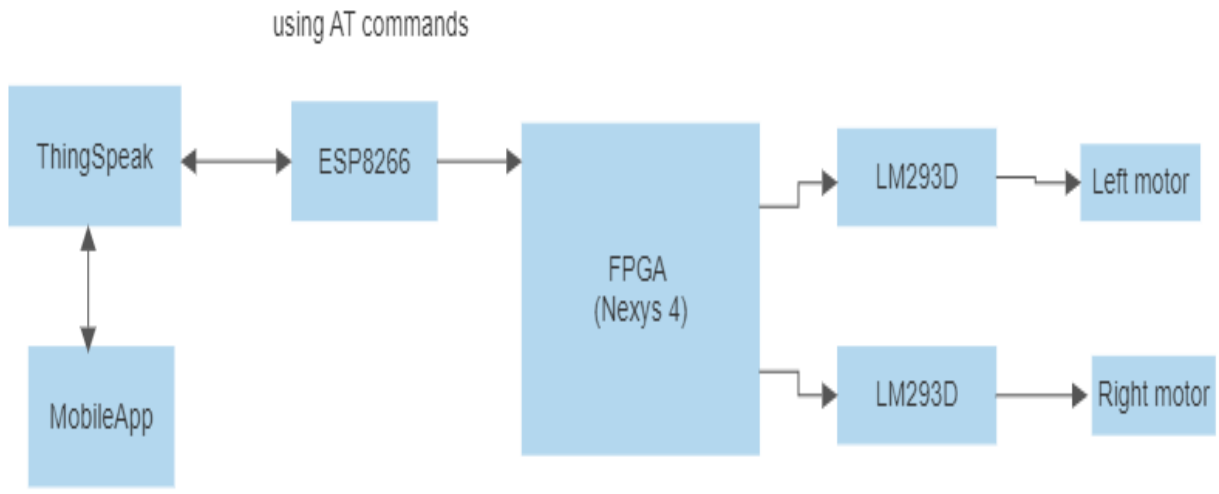
In this study, an FPGA-based speech recognition system for robot control with specific input speech has been provided. To operate the system, we created hardware based on DE2 components and coded software that was incorporated in the Nios II.

The recognition process and algorithm are straightforward and enable our system to control other devices. This opened the door to the creation of integrated circuits for use in compact control systems, such those used to operate robots.[2]

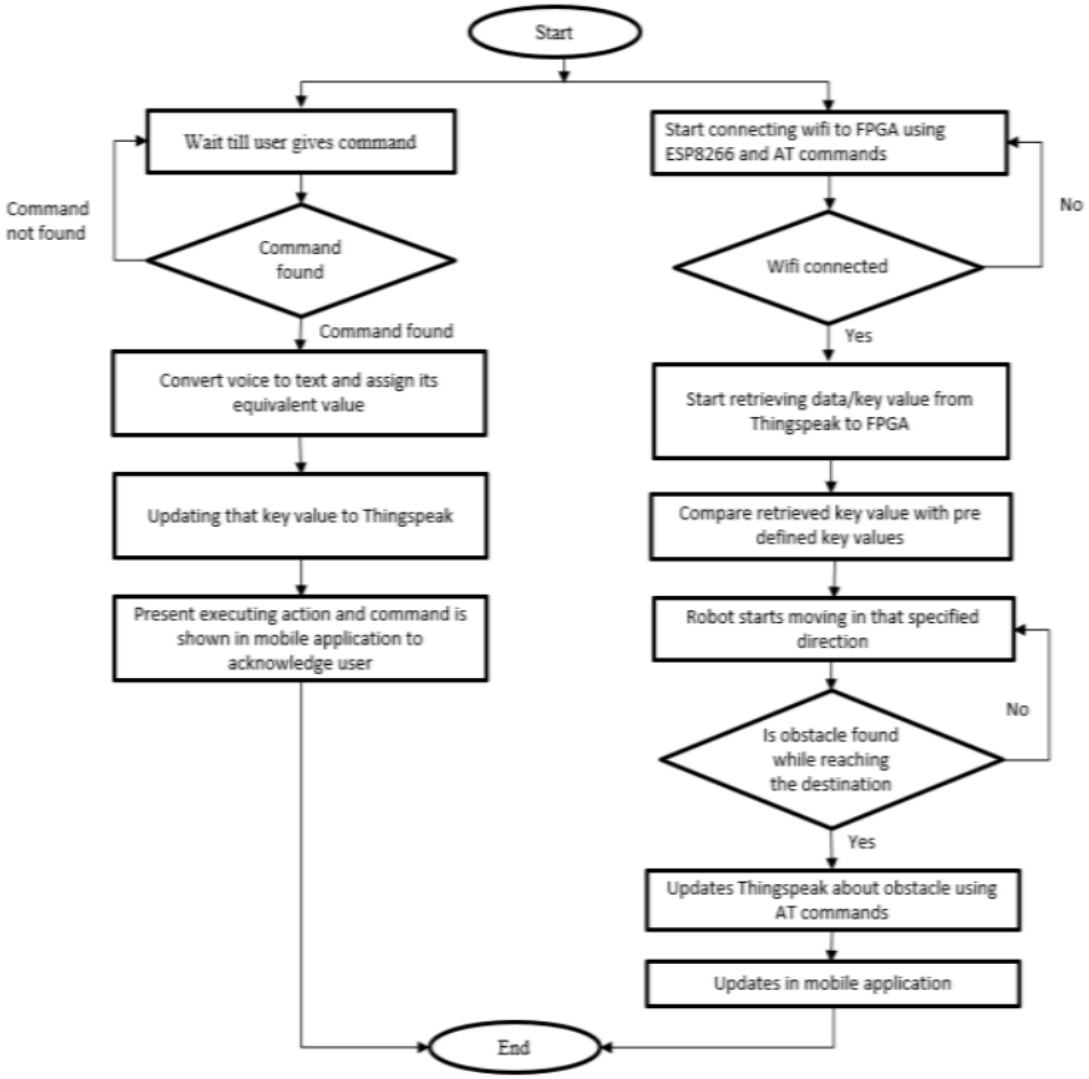
NodeMCU is used to control a low-cost autonomous vehicle that will be operated by voice

instructions provided by the user. The car was built with ESP 8266 Wi-Fi, and the user may operate it with voice commands using Google Assistant. Simple orders like forward, backward, left, and right are carried out. The vehicle reacts to input and does so in accordance.[3]
Speech recognition technology and utilising speech to direct the robot's movements. The project's workflow is analogous to taking voice as input from the microphone and then converting it into a digital signal using the hardware's ADC module. The signal is quantized after being processed in NIOS II and translated into the frequency domain using FFT. The robot is given the instruction signal to behave in accordance with the input voice.[4]
One of the major difficulties and areas of study interest brought forth by new technology is self-autonomous navigation robots. The goal of this study was to use a Field Programmable Gate Arrays (FPGA) chip to operate a robot utilising the Internet of Things (IoT) and a Wi-Fi module. Robot controlled by the Internet of Things was created using the Nexys-4 and Verilog hardware description language.[5]

Block Diagram:



Design Flow:



The system begins after receiving voice commands from the user, which are then converted into text using a mobile application and the speech to text API. Thingspeak has that text stored. The ESP 8266 Wi-Fi module is connected to the FPGA. AT commands are used to establish connection between the FPGA and Wi-Fi module. When the Wi-Fi module is connected, communication between the FPGA and Thingspeak is established. Data is sent between the FPGA and Thingspeak via AT commands. When FPGA receives a command from Thingspeak, it compares it to all the predetermined command sets it has stored there before notifying the user if the command was located or not. Robot begins gathering information from thing talk and carrying out the user's planned action if the order is discovered.

Reference:

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