**SOLAR POWERED GOLF CART WITH SPEECH RECOGNITION**

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***Abstract:***

**In this report, we document the research and engineering practices that were used to design and implement a solar powered golf cart with speech recognition. We also discuss the construction of the solar panels on the golf cart, as well as the software involved in speech recognition design. We used some circuitry techniques to do some basic functions including, turning on the lights, starting the golf cart, and raising and lowering the solar panels for optimal efficiency. The main components of the system include a speech recognition board that was programed to recognize individual voices and phrases. A circuit network was systematically designed so we could implement multiple functions at once, simply and safely.**

***Objective:***

* Maintain a stable supply of power to the golf cart exclusively from the solar panels.
* Create a security protocol so that only trusted individuals can operate golf cart.
* Configure SpeakUp Click board to different frequencies to allow for various individual speech recognitions.
* Seamlessly switch between voice command to golf cart function, error free.

***Materials and Methods:***

The golf cart gifted to us has a total of six 8Vdc batteries connected in series, making for a total of 48Vdc at our disposal. Originally, a 16Vdc to 12Vdc regulator was installed in the golf cart because the lights on the golf cart couldn’t endure the 16Vdc and only using one battery was not enough power to turn them on. Fortunately, we were able to build our own lights using four blue LED lights connected in series that could withstand the 16Vdc. In the end, using two of the batteries we were able to power most, if not all, of the circuit board we built.

The speech recognition board used for this project is the SpeakUp Click board that is set up to recognize over 200 different voice commands and have the on-board Microcontroller Unit carry them out instantly. Unfortunately, the SpeakUp Click board is structured to function at 3.3Vdc and to only withstand that much voltage; any more will instantly burn the board rendering it inoperable. So, a 12Vdc to 3.3Vdc regulator was inputted on the circuit to control the input leading to the SpeakUp board. Although it is a 12Vdc to 3.3Vdc converter, it was tested with 16Vdc and not only did it still convert down to 3.3Vdc but the extra 4Vdc did not damage it in any way even during an extensive period.

SpeakUp Click board is configured to recognize individual speech frequencies through a microphone whose receiver is connected to the audio jack on the SpeakUp Click board and is powered by the same golf cart. Five separate output pins on the board are configured to five different words: “Raise,” “Lower,” “Start,” “Lights,” and “Security.” To implement the security protocol, an AND logic gate was set up with “Security” going into four of the inputs in conjunction to one of each of the other four commands. Once “Security” is applied it will set all four inputs to high (1). From then on, saying any of the other four commands will set up each individual command to high (1). Once “Security” and the other command are both set to high the output will then be set up to high (1). A screenshot of a cell phone

Description generated with very high confidence

Through trial and error, we discovered that when the power was initially applied to the circuit board all inputs would, for a fraction of a second, turn high; making all outputs high. “Raise” and “Lower” cannot be simultaneously turned on because they are connected to the same output. While a microsecond isn’t very long to most in our case it was long enough to cause major damage; the circuit board would momentarily get short circuited and some of the components would burn. To solve this problem 10k Ohm resistors were connected to all inputs off the AND gate and were grounded. By doing this when we initially turn on the power instead of toggling the inputs of the AND gate all the power would go directly to the ground.

Once the output is activated it will go through a 1,000 Ohm resistor to regulate the current that goes into the 2N3904 transistor, as a safety precaution to not burn it. With the output being set to high, it will saturate the transistor to trigger the 12Vdc power relay. Once the relay is triggered the switch will be initiated and “Normally Open” will be closed; a 1N4001 rectifier diode is set up in parallel to the relay for protection.

Four stages of transistor and relay configurations are set up, depending on their function the “Normally Open” and the output is set accordingly. “Start” and “Lights” are powered by 16Vdc so “Normally Open” is connected to 16Vdc and once its closed the outputs will be connected to their respected commands i.e.: to the lights and the ignition. Similarly, “Raise” and “Lower” are powered by a +24Vdc and -24Vdc so “Normally Open” is connected to each voltage source respectively and once its closed the outputs will be connected to the actuators. The positive and negative 24Vdc are coming from three of the 8Vdc batteries, connected in series, located in the golf cart.

In addition to the on commands some off commands where implemented as well. Using the software on the SpeakUp Click instead of turning the outputs high we lowered them with certain commands. As mentioned above “Raise” and “Lower” cannot be turned on concurrently, so when either one of the commands is given the other one will go low, essentially, we toggled them with each other. Also, “Stop” command was placed to turn “Raise” and “Lower” outputs low, essentially turning them both off. Finally, “Off” command will turn all the commands off.

***Conclusion:***

Using circuitry techniques, we build a circuit to recognize individual voices and phrases to implement certain commands. Using the SpeakUp Click board along with an AND logic gate we could put into effect a security password and each individual command to be spoken into action. In conjunction with a series of transistors and relays each action was able to be implemented into functioning certain sections of the golf cart i.e. the ignition, lights, and actuators.

***Implications:***

Numerous technologies are constantly emerging with widespread applications concerning the field of human machine interaction in Speech recognition. The process on how it works is by converting speech signals into a sequence of words or other linguistics in a form of an algorithm implemented into a computer program. To better understand on how speech signals work we must first break them down into two types of information. One is what is the user speech content and the other being the speaker’s identity. Speech recognition aims to remove the lexical information from the user’s speech signal by reducing the inter-speaker variability. Speech recognition main goal is to extract the identity of who the person is.

The speaker’s identification allows the use of speech to verify one’s identity to control, command, and access certain objects or services. Speech Recognition offers greater liberty to service the physically handicapped in many applications. For example, manufacturing process, telephone service, and medicine are all very good examples. Below in Figure 2(a) explains how speech recognition without speech identification. Figure 2(b) shows how speech recognition works better with speech identification. With this, the database is divided into smaller divisions (SP1 to SPn) with respect to who is speaking.



Figure.2 (a) Speech recognition system without speaker identification

Figure.2 (b) Speaker identification followed by speech recognition

Demand for alternative energy sources has increased dramatically over the last few years. The oil demand is high with many countries depleting their resources faster than expected. In addition, there is a greater concern on the emission of carbon dioxide. The carbon dioxide is gradually crating a warming environment in the planet. The need for renewable energy sources is of the utmost importance. Solar energy has been in the forefront, the material in the solar panels absorb photons to convert it into electrical energy. The current electric golf cart will be modified with solar panels and as the solar panels charge from the sun, the panels will charge the golf carts battery pack.