DTMF Based Robot for Floating Solar Panels

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Abstract

In the age of highly advanced technology systems, there are many methods of remotely control systems have been developed and these are the methods which have the capability to control the various technological systems and devices. This paper will present an effective technique for an individual to monitor and control the robot for the cleaning of floating solar panels with the help of mobile phone. The automation helps in improving the lifestyle of the control of devices. This approach is based on DTMF (Dual Tone Multi Frequency). This paper suggests a method for control the robot using DTMF tone generated when the user presses the mobile phone keypad buttons when connected to a mobile phone which is connected to the robot. The biggest advantage of this type of technique is that it can operate from any distant area.

Keywords: *Floating Solar Panels, DTMF, DTMF Based Robot, Digital Electronics*

1. Introduction

The remote control technologies have been used in the places like industrial automation, space exploration, in places where human access is difficult. The proposed system attempts to provide a cost effective robot which is operated by a user through a mobile phone that is used to make a call to the mobile phone which is attached to the robot. At the time of a call, if any button is pressed, a tone corresponding to the button that is pressed is heard at the other end of the call (mobile phone connected to the robot). This tone is called DTMF Tone. The robot detects this DTMF Tone with the help of the phone connected to the robot. 'Dual Tone Multi-frequency' is one of the techniques for converting the analogue signal to digital using DTMF decoder. The DTMF decoder circuit mostly used in mobile communications system which recognizes the sequence of DTMF tones from the standard keypad of the mobile phone. DTMF Technology can be used in different applications like Home automation System, Automatic Garage Door Opening System, Cell Phone controlled robotic vehicle etc. The paper is basically focused on floating solar panels and its cleaning through a DTMF Controlled Robot. Floating Solar Power Plant is a new and emerging concept in India. In this system the solar photovoltaic panels are installed on water bodies such as lakes and ponds.

2. Why do we need Floating Solar Panels?

India is a place where we have a huge multitude of population and as we know land is scarce and it also just not scarce but it has multiple uses as land can be used for agriculture, used for industries, used for settlement etc. and in today's world land acquisition as such becoming a more of a problem. One of the biggest enemies of solar power plant is the dust accumulation on solar panels. But in case of Floating Solar Panels dust accumulation is not as much as compare to other Solar panels.

Unlike other solar panels, Floating solar panels are the one in which maintenance or cleaning is not possible by an individual as it is difficult to physically access the panels regularly. So this project focuses on how a robot can be controlled via mobile phone from any distant area for the maintenance or cleaning of floating solar panels.

3. Robot for Floating Solar Panels

In this project the robot is controlled via mobile phone that makes a call to the phone connected to the circuit. At the time of the call if any of the button is pressed, then a tone corresponding to whatever the button pressed is heard at the other end of the call. This tone is known as Dual tone multiple frequency or DTMF. The received tone is then processed by the microcontroller which is connected on the ARDUINO with the help of the DTMF decoder module. The decoder decodes the DTMF tone into the binary digit and the binary digit is sent to the microcontroller. The motor driver is connected to the ARDUINO in order to drive the motor in all the four directions. The mobile phone which makes the call to the connected phone acts as a remote controller to the robot. Here in this robot, we have attached a blower which acts as a cleaning mechanism for the panel, also we can connect a brush in place of blower just in order to remove the dust particles or dirt accumulated on the panel.
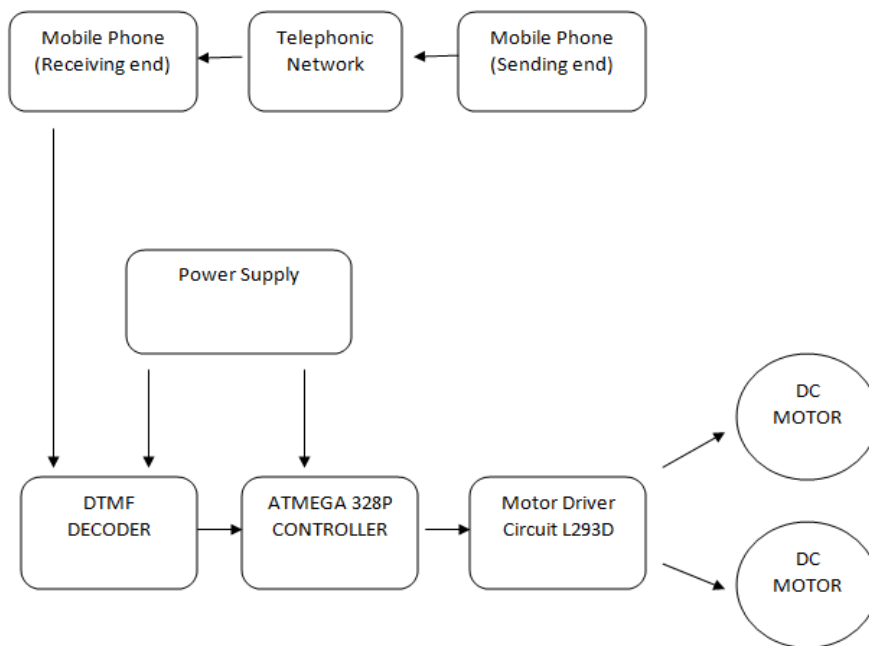
Figure 1. Block Diagram of DTMF Based Robot

4. Hardware Description

4.1 DTMF Decoder

Dual Tone Multi Frequency (DTMF) is used to detect that which of the key is pressed in the mobile phone. By pressing any of the key in the mobile phone a unique tone is generated which basically consist of two further frequencies, the one is of the higher range and the one is of the lower range.
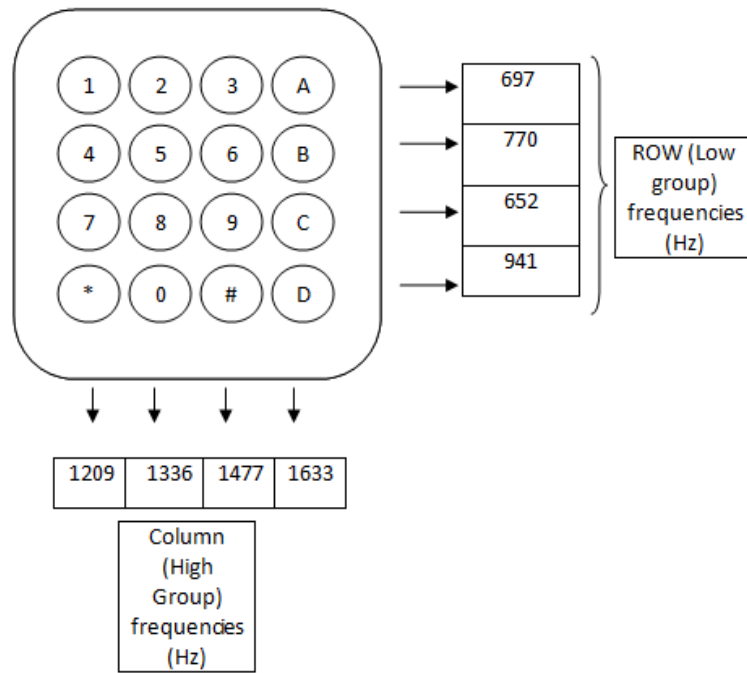
Figure 2. DTMF Keypad Frequencies

The DTMF phone keypad is based upon a 4x4 matrix of push buttons in which each row represents the low frequency component and each column represents the high frequency component of the DTMF signal. Each of these tones is composed of two pure sine waves of the low and high frequencies superimposed on each other. These two frequencies explicitly represent one of the digits on the telephone keypad. The MT-8870 is a DTMF Receiver that integrates both band split filter and decoder functions into a single 18pin DIP package. It is manufactured using CMOS process technology. The MT8870 offers low power consumption (35 mW max) and precise data handling. Its decoder uses digital counting techniques to detect and decode all 16 DTMF tone pairs into a 4-bit code.

4.2 DTMF Tone Decoding Algorithm

Table 1. DTMF Tone Algorithm

Low frequency group	High frequency group	Digit	OE	D3	D2	D1	D0
697	1209	1	H	0	0	0	1
697	1336	2	H	0	0	1	0
697	1477	3	H	0	0	1	1
770	1209	4	H	0	1	0	0
770	1336	5	H	0	1	0	1
770	1477	6	H	0	1	1	0
852	1209	7	H	0	1	1	1
852	1336	8	H	1	0	0	0
852	1447	9	H	1	0	0	1
941	1209	*	H	1	0	1	0
941	1336	0	H	1	0	1	1
941	1477	#	H	1	1	0	0

4.3 DC Motor Driver L293D

DC motor is electromechanical device that converts electrical energy into mechanical energy that can be used to do many works. It can produce mechanical movement to moving the wheels of the robot. DC motor has two wires, we can say them positive terminal and negative terminal, when these wires are connected with power supply, the shaft rotates. L293D chip is very safe to use for DC motor control. L293D is a 16bit chip which is designed to control four DC motor In L293D, there are two inputs and two outputs for each motor. There are two Enable pins on L293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with left H-bridge we need to enable pin 1 to high. And for right H-Bridge we need to make the pin 9 to high. If anyone of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It works like a switch.
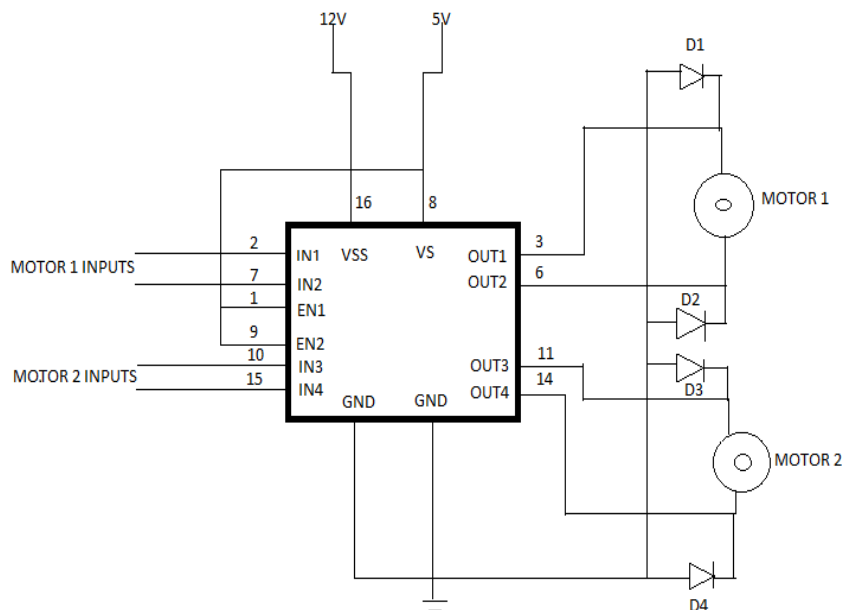

Figure 3. L293D Motor driver

There are 4 input pins for L293D, pin 2 and 7 and pin 15 ,10 as shown in the diagram. Input pins 2 and 7 will regulate the rotation of motor connected across the pin 3 and 6 i.e motor 1 and input pins 10 and 15 for motor 2 which is connected across 11 and 14. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1.

5. Working of Robot

- Mobile phone which is connected to the robot is kept in an auto receiving mode.
- In order to control the robot, we have to make a call to the mobile phone which is connected to the robot using earphone jack. So both the mobile phones are connected via mobile network.
- When the call is automatically received then press the button in the other mobile phone.
- DTMF tone is received by the mobile phone that is connected with the robot through earphone jack.

- These signals are further received by the DTMF decoder which is used to decode the signal in binary sequence to the microcontroller.
- Controller is programmed and thus robot will move when pressing the required key in the mobile.
- Microcontroller outputs are in binary form. The high output of the controller drives the motor driver to drive the motor in forward direction. Similarly the motor can move in backward, left, right motion, and stop condition.
- According to the source code given here, key 2 is for forward, key 4 is for left rotation, key 6 is for right rotation, key 8 for reverse rotation in this robot navigation.
- Further in order to clean the floating solar panel the robot is provided with a blower or fan in order to remove the dust particles. Also the functioning of fan is controlled via controller which is programmed by the user. The fan works as the robot is in ON condition and it will starts as the robots stops working.
- In order to have a proper inspection of Panel then a camera can also attached to the same robot and it will provide a proper footage to the other side so if there is any damage or maintenance is required then a user can see through a video and provide proper maintenance to the panel.
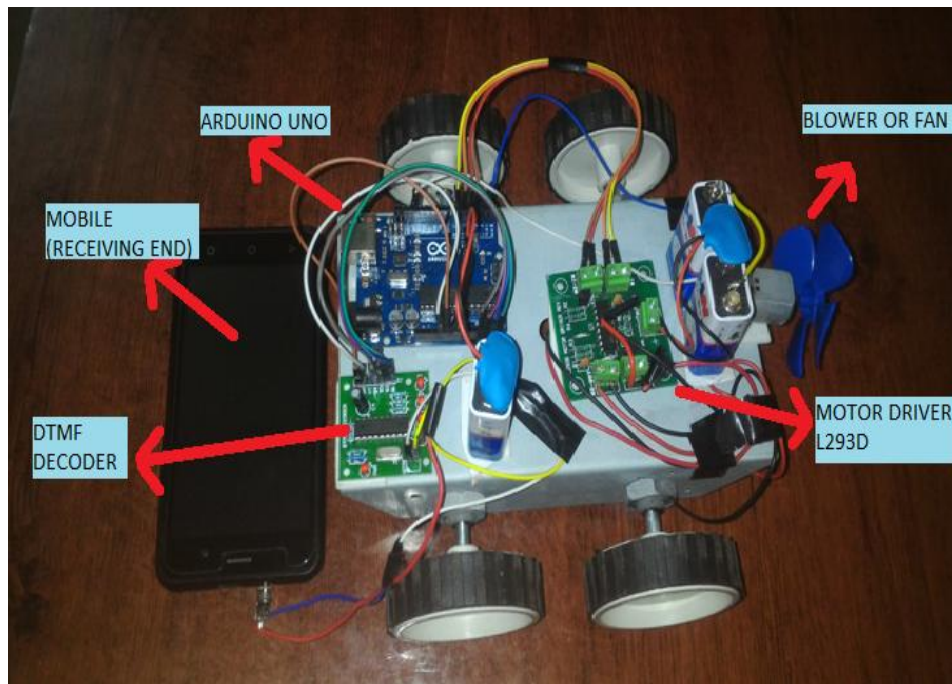

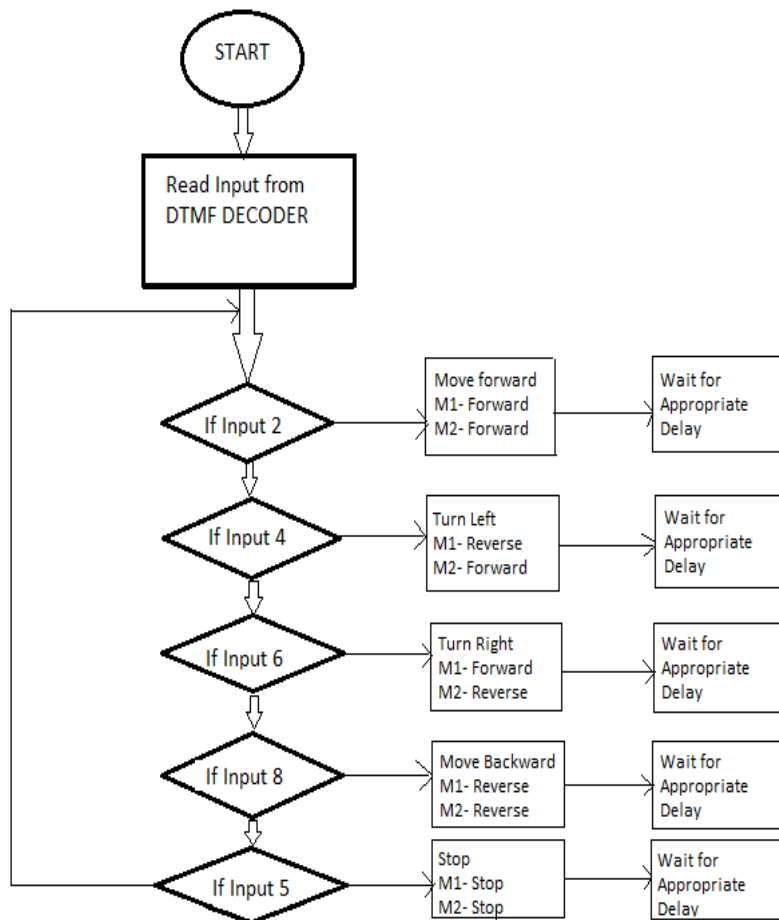**Figure 4. Designed Robot**

6. Proposed Method

Figure 5. Proposed Method of Robot

7. Conclusion

By developing this type of robotic vehicle, we have overcome the drawbacks of RF communication which have a limited range whereas this DTMF Based robotic car can be controlled from any distant area from anywhere just using this DTMF technology. In this project with the use of a mobile phone for robotic control we can overcome the problems or limitations for the cleaning of floating solar panels. It provides the advantages of robust control, working range as large as the coverage area of the service provider, no interference with other controllers.

8. References

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