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Dual Tone Multi-Frequency Based Water Irrigation System

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Abstract: Advancements in technology have made it easier for humans to complete tasks with less human force and time. This project aims to use a telephonic signalling approach using Dual tone multi-frequency (DTMF) technology to control electrical loads, such as irrigation water pumps in inaccessible areas. The system uses a decoder to switch on and off desired loads, reducing the need for manual operation in agricultural fields and households. This system can save time and ease the burden on farmers by reducing the need for manual operation.

Keywords: DTMF, Touch-Tone, DTMF generation, DTMF detection, DTMF decoder

I. INTRODUCTION

Dual-Tone Multi-Frequency (DTMF) signaling underpins modern telecommunication interfaces, enabling reliable digit conveyance across analog and digital networks. From its inception in the 1960s to its integration in VoIP and machine-learning systems today, DTMF remains vital for telephone dialing, interactive voice response (IVR), remote control, and security verification. This article provides a comprehensive technical exploration of DTMF's operation, standardization, applications, and contemporary advancements.

II. OVERVIEW OF DTMF SIGNALING

DTMF employs simultaneous transmission of two discrete audio frequencies—one from a "row" set and one from a "column" set—to encode each keypad character. Originally standardized by the International Telecommunication Union and adopted globally, DTMF is also known by the trademark "Touch-tone." The analog nature of DTMF signals means decoders must balance frequency precision, amplitude thresholds, duration, and noise immunity.

III. FREQUENCY ALLOCATION AND SIGNAL GENERATION

DTMF frequencies are organized into a 4×4 matrix, assigning a unique pair to each of 16 keypad symbols (0–9, *, #, A–D).

Generation involves summing two sinusoidal signals corresponding to the selected row and column frequencies, typically produced by keypad scanning and digital-to-analog conversion in telephones.

	1	5	5	
	1209 Hz	1336 Hz	1477 Hz	1633 Hz
697 Hz	1	2	3	А
770 Hz	4	5	6	В
852 Hz	7	8	9	С
491 Hz	*	0	#	D

Table: DTMF	Frequency	Allocation	by Row	and Column
radic. Drivin	ricquency	mocation	0 9 100 10	and Column

IV. WORKING

• Here we have connected a mobile phone using aux wire to the DTMF decoder circuit.

• If we press any key on the mobile phone then the corresponding row and column frequencies are given to DTMF decoder.

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• Here the DTMF decoder will mix those frequencies and generates corresponding binary value.

	Digital output							
Q4	Q3	Q2	Q1	1	2	3	A	697
0	0	0	1	\square	\frown	\frown	\frown	
0	0	1	0	4	5	6	B	770
0	0	1	1					
0	1	0	0		8	9	C	852
0	1	0	1	Ċ	9	9	9	
0	1	1	0					0.41
0	1	1	1	<u> </u>	0	#		
1	0	0	0					
1	0	0	1	1208	1226	1477	1622	
1	0	1	0	1205	1000	1477	1000	
1	0	1	1	Ce	alumn (Hi	ah Grou	2)	
1	1	0	0		Frequenc	ies (Hz)	-,	

Fig No.1.Dtmf Decoder

• The DTMF decoder output is connected to driver IC.

• Here the driver IC is used to drive the relays for supplying the constant voltage.

• Here the relays are connected to the driver IC.

• Relay is ON when the decoder output is HIGH otherwise the relay is OFF state.

The outputs of relays are Q1, Q2, Q3, Q4 and they are connected to different electronic appliances like AC, FAN, MOTOR.

• If Q1 is 1(i.e.; HIGH) then the corresponding device is ON.

• If it is O(i.e.; LOW) that device is OFF.



Fig No.2.Circuit Diagram

To use the system, the user needs to call a specific mobile number linked to the system and use DTMF tones to turn ON and OFF specific loads. For example, dialing 1 turns on load 1, and dialing the same number again turns it OFF. The same applies to loads 2, 3, 4, and 5. The system does not require the use of a microcontroller. The circuit uses a standard power supply consists of a step-down transformer that converts the 230V AC PRIMARY SECONDARY 12V AC input to 5V DC output. The output of the transformer would be connected to the input of the relay. Overall, the system works by receiving DTMF signals from the mobile phone, decoding them using a DTMF decoder, storing the digital signals in a flip-flop, and triggering the relay driver to switch the control panel ON and OFF. The optocoupler is used to ensure that the high voltage from the telephone line does not damage the other components in the circuit. The user at the transmitter makes a call to the mobile at the receiver due to the auto call lifting the signal from the transmitter mobile gets transmitted. According to the input applied by the user from his keypad, the DTMF decoder

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decodes the input and controls the devices at the output. Thus, agriculture appliances are controlled in a simple way by using DTMF decoder without using micro controller.



Fig No.3.Block Diagram

Sr.No.	Components	Rating	Quantity	Costing
1	DTMF	-	1	150 Rs
2	Relay	5V	3	20Rs
2	Connecting Wires	-	1	5Rs
3	Bread Board	-	1	50Rs
4	Aux Wire	-	1	50Rs
5	Resistor	100K,300K,1K	5	20Rs
6	Capacitor	0.1mF	4	44Rs
7	Crystal	3.57	1	-
8	Mobile Phones	-	1	1500Rs
9	LEDs	-	10	20
10	Voltage Regulator 7805 IC	7V-35V-IC = 1A.	1	-
11	Transformer	12V, 1Amp.	1	-
12	Submersible control panel	1 Phase-230	1	2000
13	Submersible motor	1 Phase	1	10000
14	Water Storage Tank	-	1	2000

VII. COMPONENTS USED

DTMF Decoder (MT8870)

MT8870 decoder is a single 18 – pin Dip (Dual in line package) Integrated Circuit (IC) that receives any of the 16 DTMF tone pairs, separate the signal into its low and high frequency with the help of band split filter, decode the received signal and convert them to a 4-bit digital code (0s and 1s) which are distributed to the output pins of the IC accordingly. It is the digits (1 or 3) at any given output pin of the decoder that determines the state of the load connected to the pin.

A DTMF decoder & controlling circuit receives the input commands and control the on-off mode of the connected electrical motor pump



Fig.No.4. DTMF Decoder MT8870





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Fig.No.5. Internal Structure of MT8870

Mobile Cell Phone

Mobile cell phones were used as the transmitter and receiver in this study. The transmitting mobile phone generates different patterns of the Dual tone multi frequency signal (DTMF) when any of the keys is dialed. The receiving cell phone operates in automatic receives calls to automatically establish connection with the transmitting phone when it is called.



Fig.No.6.Mobile Cell Phone

ULN 2003

The ULN2003 is a unipolar Darlington pair IC that contains seven Darlington transistors pairs with each having its input pin on the left and its output pin on the right as shown in Fig. 6. It was employed in this work for current amplification so that the output current could drive loads with higher current rating like mottos in electric fans.

The driver used to run relay circuit is ULN2003A. It is connected at the output ports of controller. This driver has the advantage of handling voltage up to 50v and current to max of 500mA. They are very suitable for turning on high power appliances such as pumps, motor, lightening etc. with isolation to lower power site components.

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1 6 2 1 з 4 5 6 7 7 D 8 П 9

Fig.No.7.ULN IC Inputs and Output Pins

Voltage Regulator 7805 IC

LM7805 IC is needed here to regulate the variable output of step down transformer to 5V constant. The series LM78XX/LM78XXA of voltage regulator is of 3 terminals and in a lot of constant output voltage levels (0-24V). Important Features-o/p current (0-1000mA), o/p voltages (5- 24v) with short circuit and overload protection

LM7805 PINOUT DIAGRAM



Submersible Control Pump Panel



Fig.No.9.Submersible Control Panel

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Fig.No.10.Submersible Control Panel

This is Single Phase 5Hp panel. It is used in agriculture area as motor starter and it is work only single phase(Phase & Neutral). This panel used for 1Hp to 5Hp & it has five features of protection like Dryrun, Overload, High voltage and Low voltage & On timer and OFF timer. The panel has four buttons to operate, the first green one is for ON, the second one is red for OFF, the third one for AUTO/ MANUAL mode

{AUTO mode- If starter is in auto mode then motor is on automatically after 40 seconds, when Power cuts off and after Power back (ON)}. (MANUAL mode- If starter is in manual mode then motor is operates when someone press the green button to start). And the last button is Set(SETTING) for set the panel, In the setting when we press SET button for 10 sec then we enter the setting and adjust the Overload,Dryrun, High volt, Low volt, On timer, Off timer and Power on timer(40 sec).when the starter is on and motor will run then panel indicates the Ampere (AMP) on the display and also indicates SPC means Set Pump Current and it takes 2 mins for set the current. After set the current it is also set the voltage and indicates on the display.

When motor ratates and water will not come then motor automatically Off due to Dryrun. And also motor takes more Ampere then also automatically Off due to Overload.

VIII PCB DESIGN



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IX. CONCLUSION

Considering the need of the physically challenged and elderly people, DTMF-based home automation has been designed that could be controlled through manual app and remotely through GSM Mobile Network successfully. The system fabricated doesn't use any microcontroller but decoder and integrated circuits which made it cost effective and convenient to implement. The DTMF based home automation designed overcomes the drawbacks of cost inefficiency, and unreliability in the places with internet unavailability. Multiple devices have been controlled in the system in the experimental phase. The user-friendly mobile application added convenience in the operation of the system. The integration of the relay in the system makes it feasible for integration with high AC voltage. DTMF has been identified as a cheap, reliable and efficient method for establishing a home automation system.

X. MERITS AND DEMERITS

Merits: -

- Remote control
- Simple interface
- Cost-effective
- Reliability
- By using this we can get a quick response
- It is not expensive to construct.
- By using this one can control the industrial appliances wirelessly
- The power consumption will be reduced and power efficiency will be increased.
- No coding is required

Demerits:-

- Maintenance And Cost
- Technical Disadvantages

XI. APPLICATIONS

- Remote Control of Water Pumps / Starter
- Agricultural Irrigation
- Wastewater Management
- Home Automation
- · Banking and financial transactions
- Telephone networks

XII. PROBLEM STATEMENT

DTMF-Based Irrigation Water Pump Control System

• Traditional manual control of irrigation water pumps leads to inefficient resource utilization and suboptimal crop outcomes.

- Lack of a streamlined, remote-controlled solution results in limited flexibility in irrigation scheduling.
- Limited infrastructure and remote agricultural setups exacerbate these challenges.
- Proposed solution: DTMF-based irrigation water pump control system.

• Enables farmers to remotely control pump operations, customize schedules, and receive real-time pump performance updates.

- Technology ensures reliable and accessible communication even in areas with limited connectivity.
- Aims to optimize water usage, enhance crop yield, and facilitate sustainable agricultural practices.
- Aims to revolutionize irrigation practices by providing efficient remote control capabilities.

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FIG.10.FINAL RESULT

XIII. FUTURE SCOPE

• Embracing digital signal processing for improved signal quality, reliability, and flexibility in harsh environments.

• Apply artificial intelligence to enhance DTMF command recognition, increase reliability and accuracy, and enable adaptive operation.

• Shrinking DTMF components for compact and less intrusive integration with submersible motor systems to increase flexibility.

• In this project in future we can add a GSM based programmable system to find out what is live situation inside the farm by sitting in home or somewhere.

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