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AN INSIGHT INTO MOTIONS CONTROLLED BY DTMF TECHNIQUE

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Abstract

Man has invented many machines and in almost all the machines, ultimately motions have been controlled by in-situ or through remote techniques. In this direction, the use of DTMF (Dual Tone Multiple Frequency) technique available in a mobile or cell phone is becoming an interesting topic, as it offers many convenient solutions for controlling the various motors both in forward and reverse directions. In fact, once a motor gets controlled, its motion can be translated in many dimensions. The Cell Phone Application group in the Incubation Cell at the SBIT has utilized two cell phones in controlling three motors. In actual situation, DTMF signals have been utilized to control three motors mounted in a robot developed at the SBIT. In this robot, two motors control the movement of the robot, while the third one is utilized to give a feedback on the commands given to the robot through a video camera, which shows the position of the robot w.r.t. the environment. In other words, the video camera can be located at a desired position. In DTMF technique, there are two mobiles, one mounted on the robot and another one is at the control end. At the control end, if any button on the cell phone is pressed, it generates a separate dual tone through DTMF codes, which are utilized in controlling various motions. This configuration is just an academic demonstration of the motion controls through DTMF technique and in terms of its applications; it is going to have wider acceptability in future. The details of the use of DTMF technique shall be

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demonstrated as well presented in details during the Conference. We present controlling of a Robot using DTMF technique and camera mounted over it.The robot is controlled by a mobile phone that makes call to the other Mobile phone attached to the robot. In the course of the call, if any buttonis pressed, tone corresponding to the button pressed is heard at the other End of the call. This tone is called dual tone multi frequency tone (DTMF).Using DTMF code; direction of motion of the robot can be controlled by Mobile phone. Robot has a RF camera that transmits an actual video at the operator's monitor.

Keywords— Mobile phones, DTMF decoder, controller, RF camera, Laptop/PCmonitor.

I. INTRODUCTION

Being able to achieve reliable communication is an important open area of research to Robotics as well as other technological areas. As interest in robotics continues to grow, Robots are increasingly being integrated in everyday life. The results of this integration are end-users possessing less and less technical knowledge of the technology. Currently, the primary mode for robot communication uses RF (radiofrequency). RF is an obvious choice for communication since it allows more information to be transferred at smaller distance. The overall goal of the project is to control robot over a long distance using DTMF technology efficiently. Today as the mobile phones are become very essential for everyone and has a vital use so to think about a mobile phone operated robot is an innovative idea. We can operate our robot from any distant or remote area. It is a wireless robot but instead of using a separate wireless module (transmitter and receiver) we are using the cell phones for this purpose. This robot has advantages over simple wireless bot as it overcomes the limitations of wireless like limited range, frequency interference etc. Mobile operated bot is having a wide range (service provider range), less fear of interference as every call is having a unique frequency and moreover it has more control keys (12 keys).The principle used for mobile controlled robot is the decoding of the DTMF tone. DTMF tone stands for dual-tone multi-frequency tone. During any call if a button is pressed, a tone corresponding to that button is generated and heard at the other end of the call. This tone is basically

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known as DTMF tone and these tones are standard one, fixed by IEEE, ISO, EIA, ITU etc. Page Layout

II. DESCRIPTION

The transmitter side is placed in the area which is to be supervised. The receiver section is placed in the operator side which receives the video from the corresponding area.

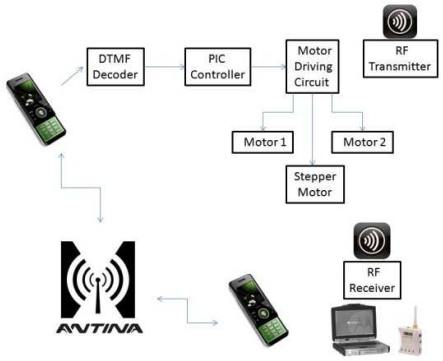

Fig. 1 Flow chart description

III.DTMF HISTORY

Before DTMF was created, telephone networks used a dialling system called Decadic (also known as Pulse Dial). The Decadic system was used extensively in modern telephone networks to dial numbers, which were entered by the telephone companies users. The Decadic (Pulse Dialling) system used a series of clicks (which could be heard through the speaker of the phone) to dial the numbers which were dialled via a keypad or rotary dial. The clicking sounds were actually the connection of the phone line being connected, disconnected, and reconnected again in a certain pattern. The Decadic (Pulse Dialling)

system was very useful, but was limited to the local exchange connections, requiring an operator to connect long distance calls.

In the late years of 1950, DTMF was being developed at Bell Labs for the purpose of allowing tone signals to dial long distance numbers, which could be potentially be dialled not only via standard wire networks, but also via radio links and or satellites.

DTMF was being developed for the future of electronic telecommunications switching systems, as opposed to the mechanical crossbar systems, which were currently in use at the time.
After DTMF was created, Decadic dialling was made pointless to continue, it made no sense to continue using that particular dialling system in the equipment circuits which the telephone exchanges were using at the time. Plans were then made to begin the manufacture of DTMF controlled switching systems in the communications exchanges and later standard customer owned telephones were upgraded to using DTMF circuits rather than Decadic (Pulse Dial). After various tests were performed on the DTMF system throughout the 1960s (when DTMF became known as Touch-Tone), DTMF was made official, and was then used as the main telecommunications dialling and switching system, and remains that way to this day.

IV. DTMF TONE

The DTMF technique outputs distinct representation of 16 common alphanumeric characters (0-9, A-D, *, #) on the telephone. The lowest frequency used is 697Hz and the highest frequency used is 1633Hz, as shown in Table 1.The DTMF keypad is arranged such that each row will have its own unique tone frequency and also each column will have its own unique tone frequency. Above is are presentation of the typical DTMF keypad and the associated row/column frequencies. By pressing a key, for example 5, will generate a dual tone consisting of770 Hz for the low group and 1336 Hz for the high group.

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	1209 Hz	1336 Hz	1477 Hz	1633 Hz
697 Hz	1	2	3	A
770 Hz	4	5	6	B
852 Hz	7	8	9	C
941 Hz	*	0	#	D

Fig. 2 DTMF frequency chart

V. DTMF EXPLOITS

Exploiting DTMF is a relatively easy task to accomplish.

First of all some general knowledge about DTMF is required, as well as a device which will produce at least the 12 standard DTMF tones. Although a DTMF decoder is not always essential when performing simple DTMF exploits, it will save you a lot of time if DTMF decoding is required.

If you are unable to obtain a Tone Dialler and you are also unable to build a White Box, it is possible to use a CD with each of the 12 or 16 DTMF tones assigned to each track, then played through a portable CD player. Another possible substitute for a DTMF producing device is a portable MP3 player used in the same manner as the CD method.

Numbers which have been blocked from being dialled on a payphone (by the specific telecommunications company who owns the payphone) can be easily be bypassed with a simple DTMF exploit (so long as it is a software block and not blocked at the exchange level). When a number is blocked on a payphone the only thing that is preventing the payphone user from dialling that specific number is the payphone's software. This software can be easily bypassed by using a DTMF emitting device. For example, if the

payphone which the user is using has the number 1234567890 blocked from being dialled, you can bypass the payphone's software block by dialling 123, then with your DTMF emitting device dial the rest of the number (4567890). This should connect the payphone user to the blocked number, regardless of any software the payphone might have to prevent that specific number from being dialled.

The theory behind this DTMF exploit procedure is that the lowest number prefix that is possible to be dialled from a payphone is three digits long. The most common payphone you will come across is the Telstra Smartphone. These specific payphones only enable the microphone (mouthpiece) to be used after 3 DTMF tones have been registered and decoded at the payphone's local exchange. After the third DTMF tone/signal has been played, the mouthpiece must be able to receive voice signals (and other signals such as DTMF) because if someone dialled 000, they would not be able to speak to the operator, because the microphone would be disabled. You are unable to use your DTMF emitting device to play the first three DTMF tones/signals because the Smartphone’s microphone (mouthpiece) is disabled. To enable the Smartphone’s mouthpiece you will need to dial the 3 DTMF tones via the payphone's keypad itself. Once the mouthpiece is enabled you are now able to send your DTMF tones/signals into the mouthpiece via your DTMF emitting device.

Decoding DTMF is a relatively easy task to accomplish, providing you have access to DTMF decoding hardware and or software. DTMF tones are always used for entering PIN numbers, ID numbers and other similar personal information via a telephone keypad. All that is involved to gain a PIN number via DTMF is some general telephone social engineering skills and a DTMF decoder of some sort (hardware or Software), as well as a tape recorder or other audio recording device.

VI.PROGRAMMING WITH DTMF

There are multiple different DTMF sequences to program the same character, it depends on the equipment, system or application you are using and or programming. For example, on a standard 3X4-matrix keypad the (1) key has no alphabetic value, only numeric. So no alphabetic characters can be

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programmed using the (1) key. The (2) key will usually have 4 different values, A, B, C and 2 whereas a differently designed keypad may have alphabetic value assigned to the (1) key, thus changing the alphabetic value of the (2) key.

When programming alphanumeric characters with DTMF, the tones are most commonly repeated until the specific character is displayed on the LCD screen or other type of monitor. Then either * or # (depending on the DTMF receiving equipment) is used to enter the currant character and begin to program the next. The * and # keys are used for entering characters and deleting characters, most commonly * is used for deleting and exiting and # is used for entering.

Not all equipment, applications or systems use DTMF to program words, they also use DTMF strings for different commands to perform certain functions on a system, application or piece of equipment.

The table below shows the alphabetic values and functions assigned to each of the 12 standard numeric keys on a standard alphanumeric keypad.

Key	Character	Key	Character	Key	Character
1	1	**2**	A, B, C, 2	**3**	D, E, F, 3
4	G, H, I, 4	**5**	J, K, L, 5	**6**	M, N, O, 6
7	P, Q, R, S, 7	**8**	T, U, V, 8	**9**	W, X, Y, Z, 9

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*	(Clear)	**0**	(Zero)	**#**	(Enter)

Note: This is the most common layout of an alphanumeric keypad. There are many different variations of keypads but generally all DTMF programming software and hardware run under the same principles.
On this specific design of alphanumeric keypad the DTMF sequence to type the letters DTMF is 3#8#6#333#.
To type the word PHREAK, the DTMF sequence is 7#44#777#33#2#55#.

The table below shows each standard DTMF sequence and the assigned alphanumeric values and functions of each tone and tone sequence.

DTMF Sequence	Alphanumeric Character or Function
0	0
1	1
2222	2
3333	3
4444	4
5555	5
6666	6
77777	7
8888	8
99999	9
2	A
22	B

222	C
3	D
33	E
333	F
4	G
44	H
444	I
5	J
55	K
555	L
6	M
66	N
666	O
7	P
77	Q
777	R
7777	S
8	T
88	U
888	V
9	W
99	X
999	Y
9999	Z
*	Clear, Reset, Back, Exit (equipment varies)
#	Enter, Ok, Next (equipment

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	varies)

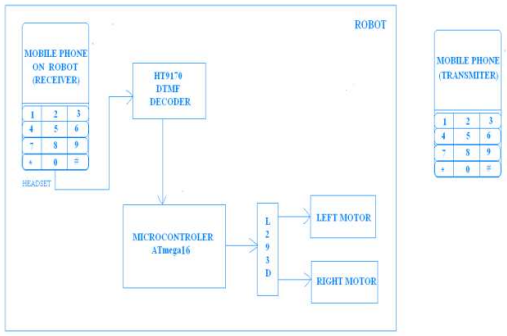

Fig. 3 working of robot (Flow Chart)

A. Working

The mobile operated robot is having basically five main phases:

1. Make a call to mobile on robot.
2. Sending the signal generated by DTMF encoder in transmitter.
3. Receiving the signal by receiver.
4. Decode the signal with HT9170 decoder IC.

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5. Process the decoded signal with on board processor ATmega16.

Firstly make a call from the remote phone to the phone attached to the robot and connect the receiving mobile phone with headset in auto answer mode. As the call is received, the connection is established between two. Now if you press a button then the DTMF tone generates a signal by adding the frequency corresponding to that button and sends to the receiver. Receiver detects it and sends it to HT9170 decoder IC which decodes the DTMF tone and fed the decoded signal to the microcontroller ATmega16 i.e. on board processor. According to the program in the microcontroller the robot starts moving.

VP and VN are the dual i/p of the op-amp; GS is the output of op-amp. When input signals given at pin1 and pin2 found to be effective then DV (pin15) becomes high, the correct 4- bit code of tone is transferred to the output pins D0-D3. The decoded digital data is then negated using 4 NOR gates of 7404 HEX INVERTER. This inverted input will be given to Port A of microcontroller. The microcontroller is programmed to give output at Port D, to control the motor driver. As the microcontroller is not able to drive the motor so a motor driver IC L293D is used for this purpose.

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DTMF data output table

Low Group (Hz)	High Group (Hz)	Digit	OE	D3	D2	D1	D0
697	1209	1	H	L	L	L	H
697	1336	2	H	L	L	H	L
697	1477	3	H	L	L	H	H
770	1209	4	H	L	H	L	L
770	1336	5	H	L	H	L	H
770	1477	6	H	L	H	H	L
852	1209	7	H	L	H	H	H
852	1336	8	H	H	L	L	L
852	1477	9	H	H	L	L	H
941	1336	0	H	H	L	H	L
941	1209	*	H	H	L	H	H
941	1477	#	H	H	H	L	L
697	1633	A	H	H	H	L	H
770	1633	B	H	H	H	H	L
852	1633	C	H	H	H	H	H
941	1633	D	H	L	L	L	L
—	—	ANY	L	Z	Z	Z	Z

Fig. 4 DTMF data output table

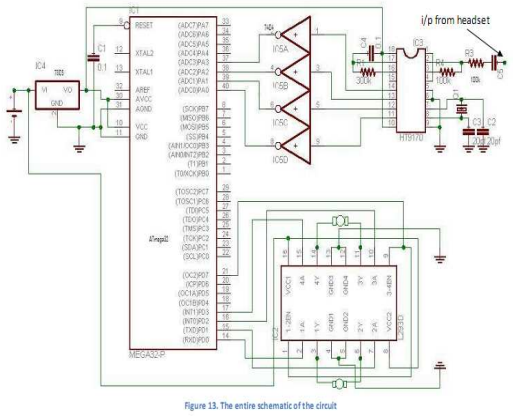

Fig. 5 The entire schematic of the circuit

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VII. MOTOR DRIVER CIRCUIT

L293D is a dual H-Bridge motor driver. So with one IC, two DC motors can be interfaced which can be controlled in both clockwise and counter clockwise directions and its direction of motion can also be fixed. The four I/O's can be used to connect upto four DC motors. L293D has output current of 600mA and peak output current of1.2A per channel. Moreover for the protection of the circuit from back EMF, output diodes are included within the IC. The output supply (VCC2) has a wide range from4.5V to 36V, which has made L293D a best choice for DC motor driver. The name "HıBridge" is derived from the actual shape of the switching circuit which controls the motion of the motor. It is also known as "Full Bridge". By using two motors the robot can be moved in any direction. This steering mechanism of the robot is called differential drive.

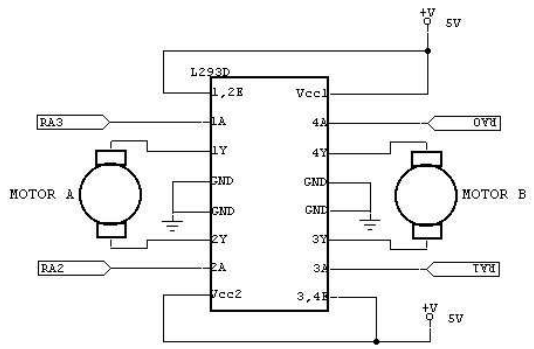

Fig. 6 Motor driving circuit with IC(L293D)

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VIII.RF CAMERA

RF camera consists of a 2.4GHz Audio/Video wireless RF Transmitter.

The most popular 2.4GHz ISM band is used and it is designed with high reliability. Airwave RF module is compliance with the criteria of FCC and R&TTE which can transmit a wide band audio & video signals up to 10 meters in an open area. RFcamera is of compact size and it consumes a low power. RF camera is composed of a highly efficient FM-FM modulation/demodulation scheme. No external audio circuits needed. The number of Channels selected is four and default value is ch4 (not enable). Other channels can be selected by applying low to enable.

Fig. 7 RF camera used

IX.RF TRANSMITTER

RF transmitter transmits video and sound to the RF receiver which is connected to the TV located anywhere (up to 100 ft. away).The RF transmitter consists of a wireless2.4 GHz technology which is combined with a wireless power source that produces a video without any delay.

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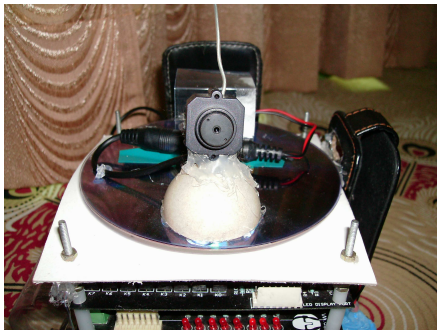

Fig. 8 RF camera transmitter used

X.RF RECEIVER

The RF Video Receiver works with Wireless Cameras. The Camera converts video into wireless radio frequency (RF) signals and transmits them to the Video Receiver which is connected to a TV anywhere (up to 30 ft. away from the Camera). The Video Receiver converts the signals back to video signals, which are fed through a cable to our TV's Video input jack.

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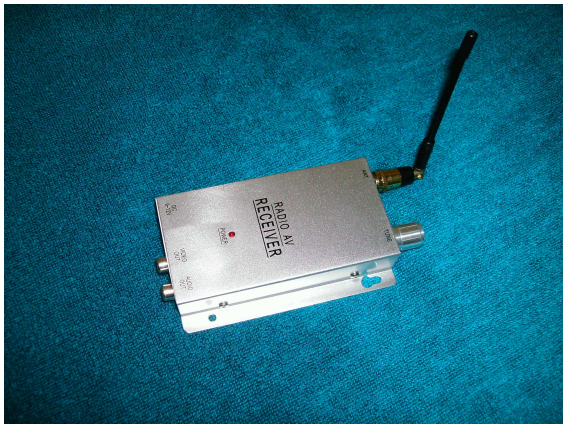

Fig. 9 RF camera receiver used

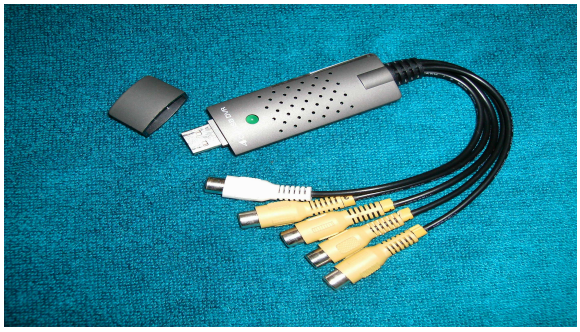

Fig. 10 RF camera receiver connector (Easy cap TV card)

XI. CONCLUSIONS

In this robot we are able to control the motions of robot by a Mobile. There are two mobiles that we have used in this robot. One mobile will be placed along the robot and other mobile will be used to call the

previous Mobile and to send the DTMF Tones. These Multi tones will help us to control the motions of a Robot.

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