CELL PHONE CONTROLLED SURVILLENCE ROBOT WITH PICK AND PLACE FEATURE.

Abstract. In the age of ubiquitous systems it is important to be able to control robots everywhere. Although many methods to remotely control robots have been devised, the methods have the problems such as the need for special devices or software to control the robots. This paper suggests a method for robotic control using the DTMF tone generated when the user pushes mobile phone keypad buttons when connected with a remote mobile robot. This project outlines the strategy adopted for establishing the kind of communication by which the phone in our hand is in connection with the phone on the robot and due to this wireless connection establishment we have our robot moving. The principle task was to programme the Arduino which was interfaced with our robot. Apart from this we have a mechanical hand on the robot which helps us picks and place things and also a dench idea of having a camera on the robot which gives us a live streaming view of the environment around the robot and the things which are picked and placed by the robot on our laptops. All these ideas for our smart robot have been successfully implemented. These details are discussed in this report.

Keywords. Mobile Controlled Robot; DC motors; DTMF; CM8870; Inverter; Mechanical Arm; Camera.

INTRODUCTION

The robot, integrated with a mobile phone, forms the crux of this project. This integrated architecture is controlled by a supplementary mobile phone, which initiates the call. Once the call is associated, any button pressed corresponds to a unique tone at the other end. The tone is termed as 'Dual Tone Multiple Frequency'(DTMF), which is perceived by the robot with the help of a cellular phone stacked in it. The received tone is fed into the DTMF decoder (CM8870), which decodes the DTMF tone into its equivalent binary. Binary output from the decoder is consequently administered by the Arduino. Arduino is pre-programmed to take necessary decisions corresponding to the given set of binary inputs. Output from Arduino is provided to both the motor drivers. The former of which acts as a regulator to drive the DC motor while, the latter can be provided to drive the motors. Cellular phone generating the call acts as a remote control obviating the need for construction of superfluous receiver and transmitter units and thus can be used for locomotion of our smart bot. This project focuses on the tele/remote control of the robot for surveillance purposes and picking and placing objects and this report provides the detailed analysis of the methodology, discussions, advantages and results.

METHODOLGY

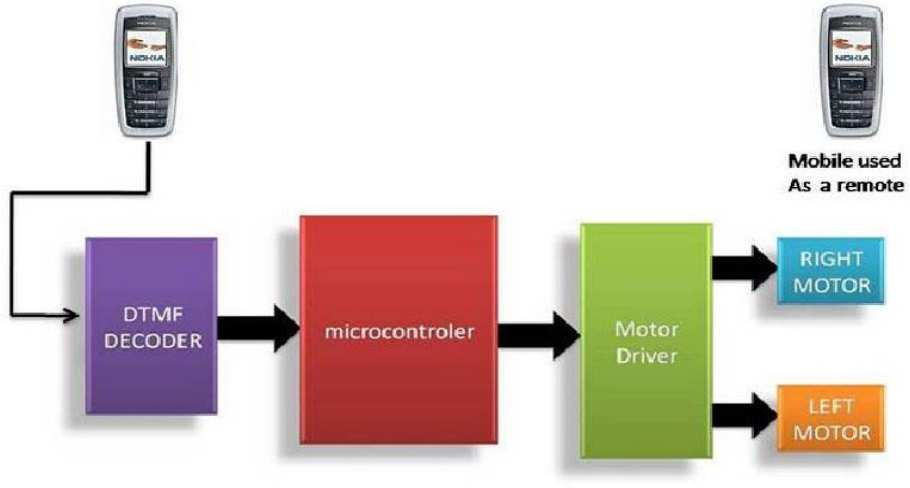

Figure 1. Block diagram of the system.

Dual-tone multi-frequency signaling (**DTMF**) is used for telecommunication signalling over analog telephone lines in the voice-frequency band between telephone handsets and other communications devices and the switching center. The version of DTMF that is used in push-button telephones for tone dialing is known as **Touch-Tone**. It was developed by Western Electric and first used by the Bell System in commerce, using that name as a registered trademark.

Prior to the development of DTMF, numbers were dialed on automated telephone systems by means of pulse dialing (dial pulse, DP, in the U.S.) or loop disconnect (LD) signaling, which functions by rapidly disconnecting and re-connecting the calling party's telephone line, similar to flicking a light switch on and off. The repeated interruptions of the line, as the dial spins, sounds like a series of clicks. The exchange equipment interprets these dial pulses to determine the dialed number. Loop disconnect range was restricted by telegraphic distortion and other technical problems, and placing calls over longer distances required either operator assistance (operators used an earlier kind of multi-frequency dial) or the provision of subscriber trunk dialing equipment. As a method of in-band signaling, DTMF tones were also used by cable television broadcasters to indicate the start and stop times of local commercial insertion points during station breaks for the benefit of cable companies.

Operation : Digits are represented by two simultaneous tones selected from a sets of five (MF 2/5), six (MF 2/6), or eight (MF 2/8) frequencies. The frequency combinations are played, one at a time for each digit, to the remote multi-frequency receiver in a distant telephone exchange. MF was used for signaling in trunking applications. Using MF signaling, the originating telephone switching office sends a starting signal such as a seizure (off-hook) by toggling the AB bits. After the initial seizure, the terminating office acknowledges a ready state by responding with a wink (short duration seizure) and then goes back on-hook (wink start). The originating office sends the destination digits to the terminating switch.

Figure 2. DTMF Dial Pad.

The DTMF keypad is laid out in a 4×4 matrix in which each row represents a low frequency and each column represents a high frequency. Pressing a single key sends a sinusoidal tone for each of the two frequencies. For example, the key 1 produces a superimposition of tones of 697 and 1209 hertz (Hz). Initial pushbutton designs employed levers, so that each button activated two contacts. The tones are decoded by the switching center to determine the keys pressed by the user.

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

Figure 3. DTMF keypad frequencies (with sound clips)

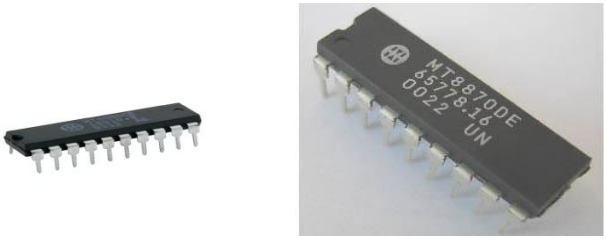

Figure 4. DTMF Decoder mt8870.

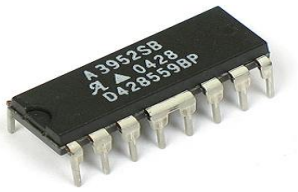

Figure 5. Motor Driver.

First of all the basic concept of the movement of our robot is done by the pressing the DTMF dial pad of the phone which is in our hand. Now we have already programmed the Ardunio for the direction of movement of our robot for the respective keys we press. We first establish a connection between the phone in our hand with a phone mounted over our robot. Then we dial keys and pass our DTMF Tones to the mounted phone. Now for example, when we press 2, the DTMF Frequency corresponding to 2 is passed to the mounted phone which in turn send the DTMF frequency to the DTMF decoder as shown above. This decoder in turn gives out the binary code value for two i,e 0010 and this binary code is sent to the Micro controller of the Arduino which is pre-programmed to move the robot forward for the binary code value 2.Simialrly it follows for 4 (binary code: 0100) for which toe robot moves right, for 6 (binary code: 0110) it goes left and for 8 (binary code: 1000) it goes backward. After the Arduino gets the values of the binary code value of the digit pressed, it send the signals to the motor driver. The motor driver then send the output signals from its output pins to rotate the D.C Motors attached to it, with respect to the signals coming out. This on a whole is the working of the Robotic system.

Apart from this we have the Mechanical Robotic arm for our bot which is the most delightful feature of our robot. It is used to pick and place objects from one place to another with the help of the motion of our robot. Our robotic arm makes use of 1 servo motor for a 360 degree movement of the arm and 2 stepper motors for the easy movement of the arm up and down when it comes to picking and placing objects and a string for the grip and hold of the arm. The arm is of a metallic cum wooden body best suited for our purpose.

We also have a camera inbuilt on our robot which helps us to have a live-streaming view of the environment around it and the objects which are picked and placed by the mechanical arm. This also helps us for surveillance purpose. We make use of Wi-Fi connection in this segment.

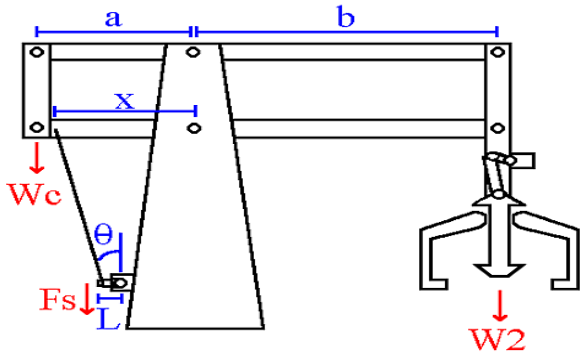

Figure 6. Simple outline of the Mechanical structure of the inbuilt Robotic arm.

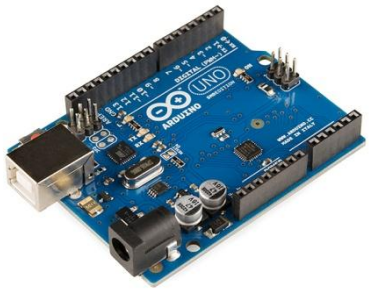

Figure 7. The Ardino v1.0.5

Main Hardware Used

- DTMF Decoder mt8870
- Smart phone devices (Number:2)
- Ardunio UNO microcontroller.
- Motor Driver
- 2 Step motors BYJ-48,5V D.C
- 1 Servo motor 360 degree application.5V D.C
- 2 D.C motors.
- Jumper Wires.
- 12 V batteries for power source.

Software Used

- Arduino v1.0.5
- 8051 IE
- The software is wrtten in ‘C Language”

RESULTS AND DISCUSSIONS

Our project is divided into 3 Major segments

1.The main DTMF Robotic System.
2.The Mechanical Robotic Arm.
3.The Live-Streaming Camera feature.

1.THE DTMF Robotic System.

The first step was taken by establishing a connection between both the phone in our hand and the phone mounted. The DTMF Decoder successfully decoded the DTMF Tone frequencies coming from the phone mounted on the robot to their equivalent binary values and sent it to the Arduino v1.0.5.The pre-programmed Ardunio using ‘C-Language ‘ was successfully seen passing the required output signals, based on the binary values it obtained from the decoder , and finally the ultimate success of the movement of the robot resulted when the motor driver sent its output signals to both the DC motors hence rotating the motors according to the numbers (2,3,4,8,A) pressed.

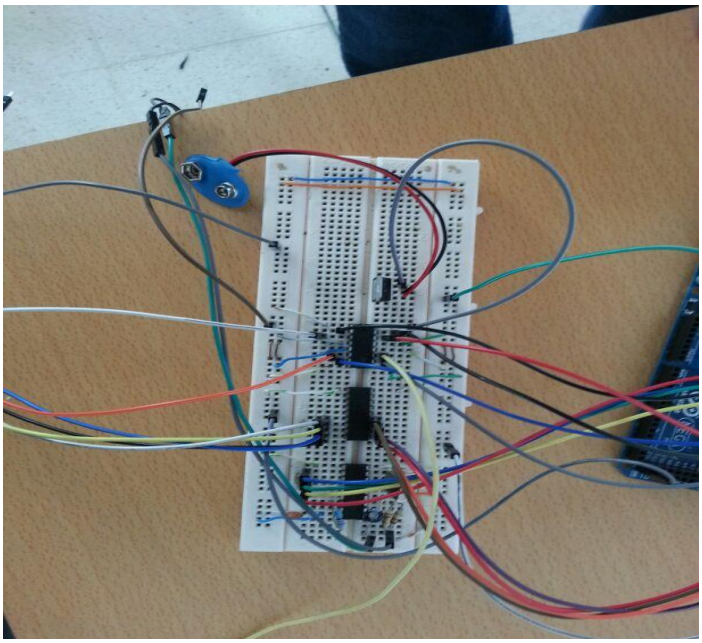

Figure 8. DTMF decoder and inverter connections on breadboard.

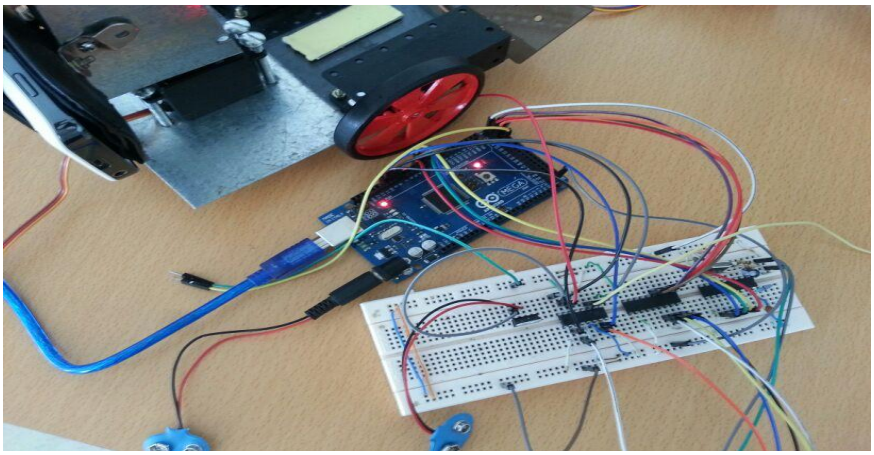

Figure 9. Circuit connection of decoder, inverter and motor driver to Arduino (Total circuit connection)

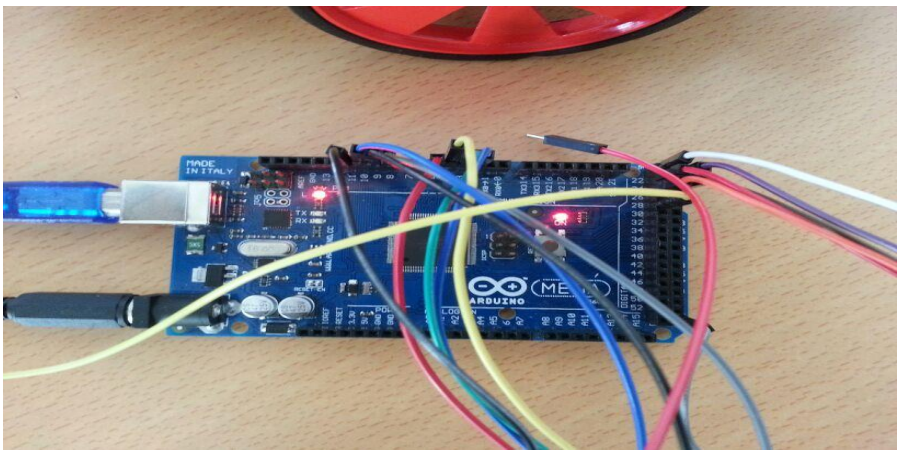

Figure 10. Ardunio connections to ports with Jumper wires.

2.The Mechanical Robotic Arm**.**

A robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm , the arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand.

Mechanical Arm built over the robot played its vital role of moving objects around it revolving 360 degrees successfully. Things were successfully picked and placed all around using the locomotive feature of the robot.

Figure 11. Step Motor BYJ-48,5V D.C

Figure 12. A 5 V d.c Servo motor used for 360 revolution of arm.

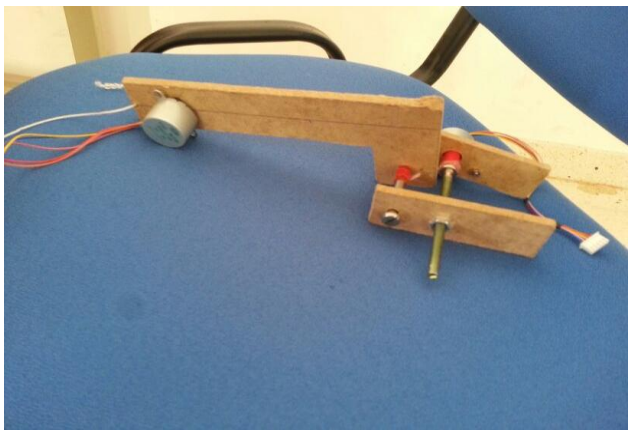

Figure 13. The Robotic Hand.

3. The Live-Streaming Camera feature.
A clear live-streaming video was established using the Wi-Fi or Wi-Max Modem which gives us the live video of the environment around the robot and the things picked and placed by the arm could be seen on the laptop with us, by the help of the phone attached to the robotic arm.

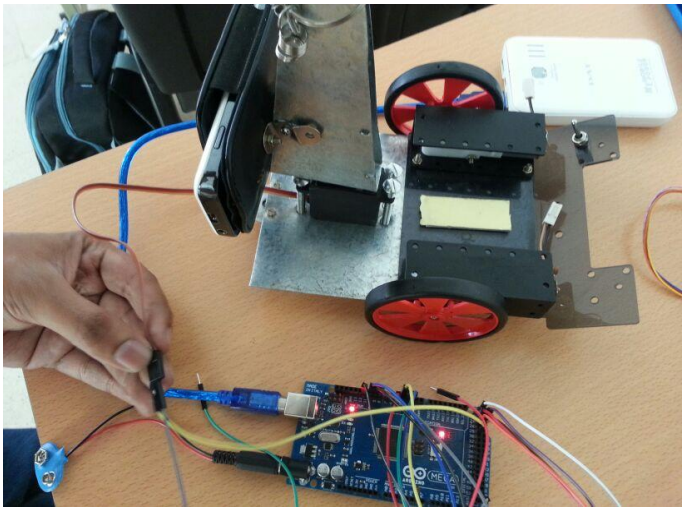

Figure 14 The phone with the camera is mounted on the Robotic arm as shown in this figure.

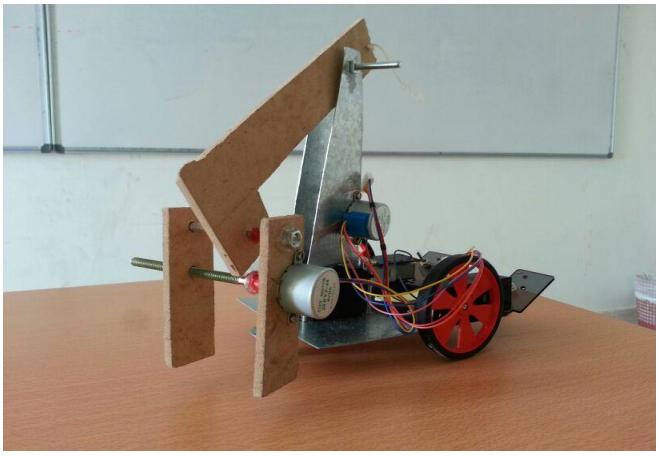

Figure 15. The Robot with the mechanical arm.

The best part about our project is that our robot has many good advantages, applications and numerous future scopes for it. They are as follows.

Advantages

1. Wireless control.
2. Surveillance System as there is a camera.
3. Takes in use of the mobile technology which is almost everywhere.
4. This wireless device has no boundation of range and can be controlled as far as there is network.

Applications

1. Scientific Application- Remote control vehicles have various scientific uses including hazardous environments, working in the deep ocean, and space exploration. The majority of the probes to the other planets in our solar system have been remote control vehicles. The sophistication of these devices has fueled greater debate on the need for manned spaceflight and exploration.

2. Military and Law Enforcement-Remote control vehicles are used in law enforcement and military engagements for some of the same reasons. The exposure to hazards is mitigated to the person who operates the vehicle from a location of relative safety. Remote controlled vehicles are used by many police department bomb-squads to defuse or detonate explosives.

3. Search and Rescue- UAVs will likely play an increased role in search and rescue in the United States. This was demonstrated by the successful use of UAVs during the 2008 hurricanes that struck Louisiana and Texas.

Future Scope

1. Password protection.
2. Alarm-Phone dialer.
3. IR Sensors.
4. LDR's

CONCLUSION

We have successfully implemented the entire circuit on the PCB. Since all we need is a mobile call establishment to instruct the robot due to the cell phone's unending and cheap availability, this is highly feasible. The level of sophistication is quite low and hence its working is user friendly. Project can also be subjected to standardization and hence has a good future scope. When it comes to the hand, we have successfully built up the mechanical arm which rotates freely without any obstruction in accordance to the pressing of the DTMF keypad and picks and places things at 360 degrees around it. Last but not the least is the Live-streaming camera feature which is successfully established over our smart robot using Wi-Fi connection and objects picked and placed and also places around it can be tracked down successfully.

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