International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 02 Issue 11
November 2015

Android Smartphone Based Intelligent Wheel Chair for Physical Challenged Patients

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Abstract—
Physically Challenged (Paralysis / Accident Cases) where some organs are paralyzed. The patients whoever suffered from this can use a wheelchair for navigation. As they can't apply full force to control their wheelchair, there will be requirement of simple application for controlling their wheelchair. The user will control the wheelchair from the Android Smartphone as per the requirement. Android Smartphone will have an application, where it will transmit some data to wheelchair for movement.

Keywords— Embedded C; ARM Processor; Bluetooth; Android smart phone

I. INTRODUCTION

The number of people who need to move around with the help of some artificial, is continually increasing. These means have to be increasingly sophisticated, taking advantage of technological evolution, in order to increase the quality of life for these people and facilitating movement and to making this increasingly simple and vigorous, so that it becomes similar to that of people who do not suffer deficiencies. Systems already exist which respond to many of the needs of people with different degrees of incapacity. However, there are still important advances to be made in this field. This justifies the numerous research programmers which are being carried out at the present time; the TIM MAN project, the COACH and the SKIL guide systems.

The main reasons for their justifications are as follows:

a) The present high level of technology in the electronic and robotic systems permits some of the mobility problems suffered by certain people to be resolved. Electronics solves the problems very acceptably for the users. This is because the electronic used is eminently suitable for coping with needs presented.

b) Unfortunately more and more people are appearing with incapacities which prevent them from carrying out normal activities. Most have serious problems related to movement.

The type of artificial aid needed by a disable person in order to move about depends, to a large extent, on the level of his incapacity. For example, in order to guide a wheelchair, various situations can be distinguished:

a) If the user is capable of controlling his head or his hands, the ideal solution is the use of a joystick.

b) Where there is a high level of incapacity, solutions are basically centred on the use of other means, such as the voice or eye movements. In this case, the presence of safety sensors is justified with the object of assisting the user to guide the chair.

c) Only in extreme case it is suggested that there may be a need for the chair to cover certain distances in an autonomous manner, without need for any intervention on the part of the user routs in hospitals, recreation centres, etc.In this case the presence of external sensors is vital.

Another important requirement that a wheelchair has to fulfil is that of responding rapidly and efficiently to the commands of the user, independently of the method used for giving commands.

In many cases / places, Care Taker is navigating the user manually with the help of simple mechanical force. There by, the user has to rely on second person for navigation.

In the proposed, the user can control the wheelchair by himself/herself without the second person by using a simple button click. An android application will be given to the user so as to navigate his/her own wheelchair from one point to another point. Sensors are mounted on the wheelchair to detect any obstacle present on its way to the end point targeted by the user.

To navigate wheelchair from one point to another point, the user will control through a simple android application designed specifically for this target. Android Smartphone will communicate with the wheelchair through a Bluetooth Stack. Bluetooth Transceiver is connected to the ARM processor, there by simple Bi-Directional Communication is established between the Smartphone and the wheelchair.

Wheelchair is controlled through a simple switching network connected between the ARM processor and the Electrical Motors of wheelchair. As the current rating, and voltage ratings of this electrical motors were high, a simple switching network (Current Amplifier, Voltage Switcher) are interfaced to ARM Processor. As the current is amplified and voltage is switched, then this wheelchair will be navigated to simple end point given by the user.

II. SYSTEM ARCHITECTURE

The system architecture of this proposed system is divided into two different blocks.

ARM7 END: Hardware implementation for this proposed system is shown below with the simple blocks. Power Supply block is designed and developed to generate power source for the ARM processor and its relevant components. Reset Circuit is designed and developed to reset the program whenever necessary and interfaced to the ARM processor for greater stable response. Clock Circuit is designed and developed to generate oscillationsand interfaced to the ARM processor for needy response. LCD Display can also interface to the ARM processor for displaying the status of the system for better understanding. A simple block diagram shown below:

BLOCK DIAGRAM

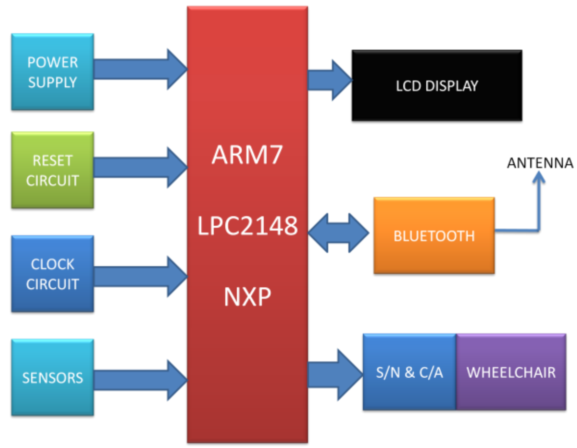

Figure – 1: Block Diagram

Data flow of this proposed solution has shown below:

Android Smartphone → Android Bluetooth → Bluetooth receiver → ARM processor → Switching network → Electrical motors → Wheelchair

III. IMPLEMENTATION

HARDWARE:

In hardware implementation, ARM processor plays a key role in monitoring and controlling the security system. Low-power consumption ARM processor (LPC2148) operating at 3.3V, 50uA is designed and mounted on a PCB along with Reset Circuit and a Clock Circuit. LPC2148, a 32-bit microcontroller with advanced RISC architecture and having 48 GPIO lines with a program memory of 32KB and a data memory of 512Bytes.

And we have 2 UART ports i.e. UART0 and UART1. In this project GSM/GPRS connected to the UART0 port of ARM7 (LPC 2148). And 1 Analog to Digital channels, though I connected one Analog sensor to ADC channels of ARM7, so that it converts

Analog Values to Digital Values. Those values i have uploaded into ThingSpeak.

ARM7 (LPC 2148) internal architecture overview has shown below as well ARM7 (LPC 2148) with LCD has shown below.

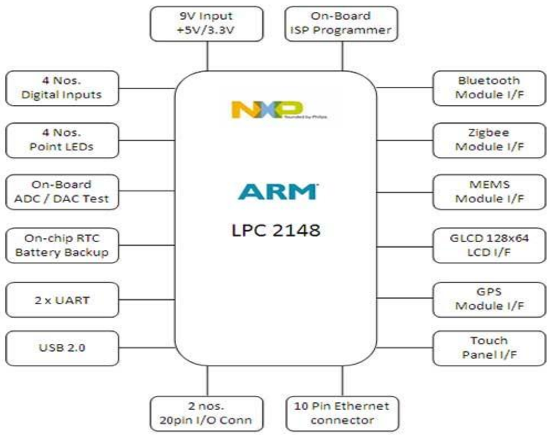

Figure – 2: ARM Overview [LPC2148]

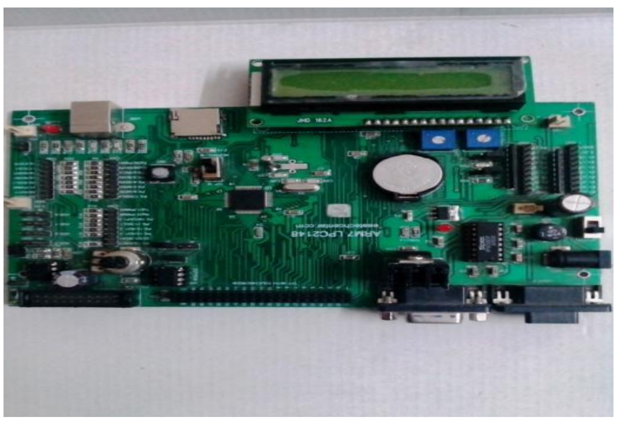

Figure – 3: LPC2148 Development Board

*Obstacle Sensor:*This is an infrared based sensor which can be used for obstacle sensing, color detection (between basic contrasting colors line sensing, encoder sensor, IR remote signal sensing, etc and also for wireless infrared communication. The sensor provides high immunity from ambient light and can be used in all light conditions quite effectively.The board can be used in two modes – as an obstacle sensor and in the other as an IR signal receiver and transmitter. The two modes can be selected with the mode selector jumper. Putting the jumper in one position (SNS) will make the sensor work as an obstacle sensor and putting it in the other position (Tx) will put the sensor in the IR signal receiving and transmitting mode. In the both the modes the sensor works on 5V input provided to the header pins labeled 5V and Gnd. Please take note not to apply voltages exceeding 5V and observe the right polarity while making connections. When using the sensor as an obstacle sensor, apply 5V at the input pins and get the output at the Output pin (Out). The sensor provides a digital output. The sensor outputs a logic zero (0V) when an object is placed in front of the sensor and a logic one (5V), when there is no object in front of the sensor. An onboard LED is used to indicate the presence of an object. The sensor can be used to detect signals from IR remotes that work on the 38 kHz frequency range. To sense these signals, put the mode selector jumper in the Tx position and sensor will detect any IR signals and output them to the Output pin. The sensor can also be used to do wireless IR communication. To achieve this you will need two sensor modules, one for transmitting the signals and other for receiving it. To do wireless communication, put the mode selection jumper to the Tx position on both the modules. Any signal (0V or 5V) applied to the Tx pin on the transmitter will appear at the Out pin on the Receiver. You may use this setup to do simple and shortrange IR communication.

Obstacle sensor Device has shown below:

Figure – 4: Obstacle Sensor

*BLUETOOTH:*Bluetooth is a proprietary open wireless technology standard for exchanging data over short distances from fixed and mobile devices, creating personal area networks (PANs) with high levels of security. Bluetooth technology allows electronic devices to communicate wirelessly.Figure shows how to interface the Bluetooth with microcontroller. Bluetooth technology handles the wireless part of the communication channel; it transmits and receives data wirelessly between these devices. It delivers the received data and receives the data to be transmitted to

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and from a host system through a host controller interface (HCI). The most popular host controller interface today is either a UART or a USB. Here, I will only focus on the UART interface; it can be easily show how a Bluetooth module can be integrated on to a host system through a UART connection. Connection between Bluetooth and controller has shown below:

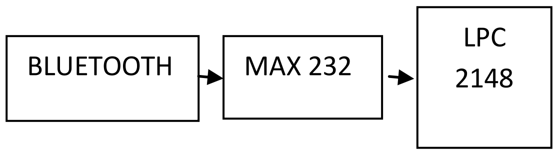


Fig – 5: Interfacing Bluetooth with ARM7

Bluetooth HC-05 has shown below:

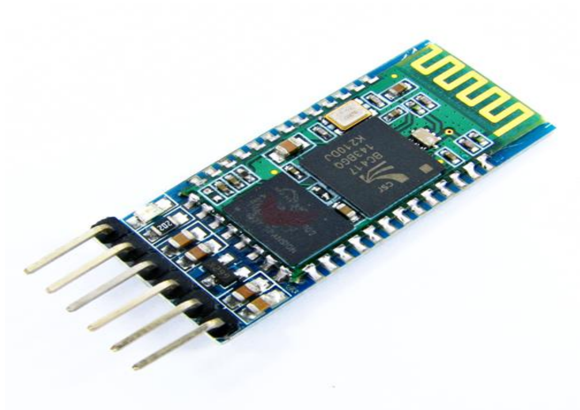
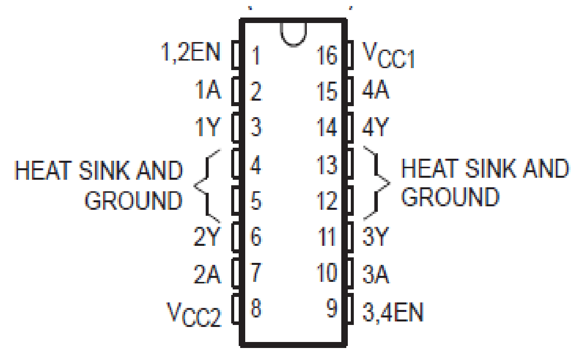


Fig – 6: Bluetooth Module

*L293D:*The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.

All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo- Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications. On the L293, external high-speed output clamp diodes should be used for inductive transient suppression. L293D pin diagram has shown below:



Final Schematic Diagram of this Project has shown below:

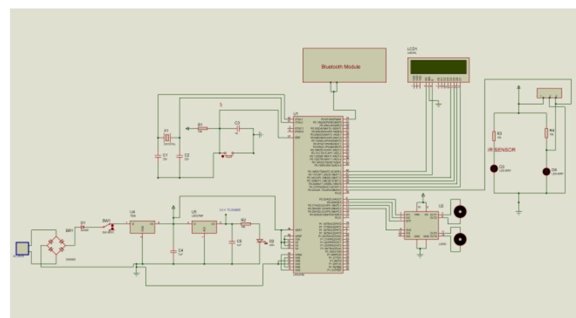


Figure – 8: Schematic Diagram

Obstacle sensor (ACS 712) connected at P0.20 and P0.21 of ARM7 (LPC 2148), Bluetooth P0.0 of Txd and Rxd connected to UART1 of ARM7. Reset Circuit and Clock Circuits were interfaced at RST, XTAL1, and XTAL2 of LPC2148.

SOFTWARE:

Here, to program ARM processor Keil uVision 4 was used as a cross-compiler and Flash Magic was used as a programmer. ThingSpeak is an open source Internet of Things application and API to store and retrieve data from things using HTTP over the internet or via a local area network.

IV. ALGORITHM & FLOWCHART

ALGORITHM:

Step – 1: Initialize ARM, LCD, and Bluetooth.

Step – 2: Wait until you see WELCOME on LCD.

Step – 3: Wait until character received.

Step – 4: If character is 'F'then wheelchair moves towards Forward.

Step – 5: If character is 'B' then wheelchair moves towards Backward.

Step – 6: If character is 'L' then wheelchair moves towards Left.

Step – 7:If character is 'R' then wheelchair moves towards Right.

Step – 8: If character is 'S' as well IR = 1 then wheelchair has stops.

Step – 9: Navigation control has done by Android Smartphone.

FLOWCHART:

The flowchart of this paper is shown below.

Figure – 9: Flow Chart

V. RESULTS

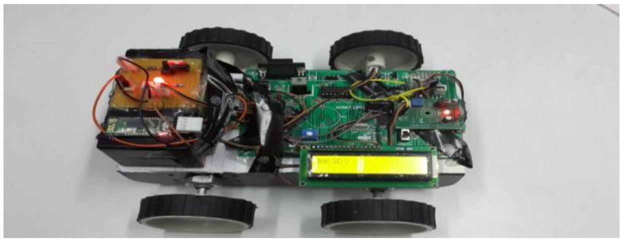


Fig – 10: Final Prototype 1

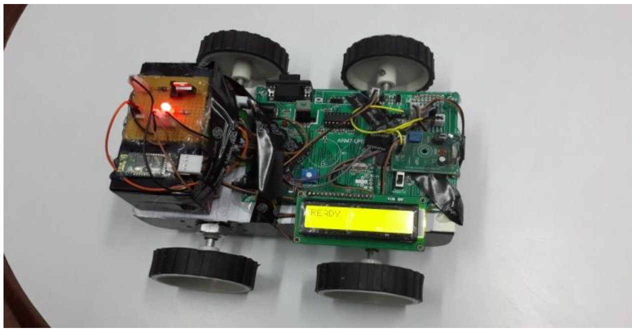


Fig – 11: Final Prototype 2

VI. CONCLUSION

In this paper, a wheelchair robot is designed and developed using Android Smartphone. An android application is designed and communicated with ARM7.

ACKNOWLEDGEMENT

We would like to express my special thanks of gratitude to all our faculties who gave me the golden opportunity to do this wonderful project on the topic (Wearable Technology), which also helped me in doing a lot of Research and i came to know about so many new things we are really thankful to them. And, secondly i would also like to thank my parents and friends who helped me a lot in finalizing this project within the limited time frame.

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Male Mallika, received her bachelor's degree in electronics and communication engineering from Malineni Lakshmaiah Women’s Engineering College. She is currently pursuing her M.Tech in Digital Systems and Computer Electronics from QIS College of Engineering and Technology. Her areas of interest are wireless communications, microcontrollers and embedded system design, Real time operating systems.

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