Multifunctional Wheelchair System Operated on Touch Pad

Mr. Rushikesh D. Maskare[1], Mr. Ashish G. Dighade[2], Mr. Dhirajkumar S. Dhawane[3] , Ms. Pallavi R. Patil[4], Ms. Neha S. Talware[5], Prof. Kirti B. Nagne[6]

[1,2,3,4,5]UG Students, Electrical Engineering, DES'sCOET, Dhamangaon Rly, Maharashtra, (India)
[6]Assistant Professor, Electrical Engineering, DES'sCOET, Dhamangaon Rly, Maharashtra, (India)

Abstract - *An automatic smart wheel chair plays a major and important role in life of disabled person. This project describes an economical solution of robot control systems. The presented wheelchair control system can be used for different sophisticated robotic applications. This paper briefs a multifunctional wheelchair for disabled mob using, touch screen, ultrasonic sensor and GSM system interfaced through microcontroller which ultimately abolishes switching technology and thus optimizing hardware cost. This project describes an economical solution of robot control systems. The presented wheelchair control system can be used for different sophisticated robotic applications.*

***Key Words*: automatic; touch screen; PIC; wheelchair; ultrasonic sensor; GSM; wireless; robotic;**

1. INTRODUCTION

The body of wheelchair is customized in such a way that touch screen panel is placed on armrest pad and rest of the circuitry is boxed just underneath the seat and above the cross brace, making the arrangement lucid, steadfast thereby letting users see just the relevant details. By enabling touch screen the user can control the mobility of wheel chair by one finger touch. Along with wheelchair movement it facilitates obstacle avoidance facility and emergency calling which leads a merit for a care taker besides just for the disabled person him/herself.

This intelligent system comprises of RF transceiver, GSM module, ultrasonic Hc-sr04, Touch screen and one PIC microcontroller which gathers command and controls the wheelchair operations accordingly. The work herein is entirely controlled by TFT touch module stm32F429 and the commands from the touch screen through RF transmitter are received by the microcontroller. The command received by PIC further decodes the signal and performs the specific operation in accordance with the option chosen on the Touch module. At times when critical situation arises, the user may need to ping some another person to seek help.

This intelligent system comprises of RF transceiver, GSM module, ultrasonic Hc-sr04, Touch screen and one PIC microcontroller which gathers command and controls the wheelchair operations accordingly. The work herein is entirely controlled by TFT touch module stm32F429 and the commands from the touch screen through RF transmitter are received by the microcontroller. The command received by PIC further decodes the signal and performs the specific operation in accordance with the option chosen on the Touch module. At times when critical situation arises, the user may need to ping some another person to seek help.

2. LITERATURE REVIEW

2.1 History and Evolution of Wheel chair

The first wheel chair was invented in the 1595 called as invalids chair was made for the king of Spain called Phillip. Later in the year 1655 Stephen Farfler built a self-propelling chair on a three wheel chassis as shown in figure. In the year 1783 John Dawson of Bath Town England invented a wheel chair named as bath wheel chair. The chair was with two large wheels and one small one. In the year 1869 patent for a wheel chair with rear push wheels and small front casters were invented, in the year 1881 the push rims for self propulsion wheel chair was invented as shown in figure. In 1900 the first spoked wheel chair was invented and in the year 1916 first motorized wheel chair was invented by British Engineers. In the year 1932, Harry Jennings built the first foldable wheel chair.

2.2 Different Types of Wheel Chairs

There are various types of wheel chairs, we are differentiating the wheel chair based on the mode of power used for drive. These wheel chairs are differentiated in to two types as below:

A) Manual wheel chair

B) Electric powered wheel chair

A) Manual Wheel Chair

The self propelled wheel chairs (Figure 1) are driven by the user by using the rear wheels (diameter of 20-26") which resembles to that of bicycle but has an additional rims know as hand rims are for the movement of the chairs by means of pushing forward or backward. The hand rims are of diameter lesser than the rear wheels. Use of two hand rims at

a time gives straight movement of the chair, use of one of the rim gives the turning movement to the chair towards left or right.

Fig.1: Self Propelled Wheel Chair

Manual wheel chairs are driven with the help of man power as source of energy for moving the chair, these are self propelled or propelled with the help of attendee.

Attendant propelled wheel chairs are those wheel chairs which are known as transport wheelchairs that require attendees help for the movement. The wheel chair is designed such that there is no big rear wheels with rim for the moving, moulded seating, light weight, push handles, support backrest, hand brake system. These chairs are commonly seen in airports to move passengers in to the seats. Manual wheel chair are again classified into two types as shown in below :

a) Rigid wheel chair

b) Foldable wheel chair

B) Electric Powered Wheel Chair

The wheel chair that runs by means of Electric motor is known as electric-powered wheelchair, this wheel chair requires navigational controls, usually a small joystick mounted on the armrest. For users who cannot manage a manual joystick, head switches are provided and chin-operated joysticks are provided, other specialist controls may also be provided for independent operation of the wheelchair. Motorized wheelchairs are useful for those unable to propel manually or who require travelling for a long distance which creates difficulty for manual operation. These wheel chairs are not only used by traditional mobility impairments but also by cardiovascular patients. Different types of electric and hydraulic power driven wheel chairs are as shown in Figure 2.

The advent of the power base, which sits beneath the seat and contains the motor and batteries, allowed for significant mechanical advancements in electric wheelchairs. The power base separated the electric wheelchair into two components: the base, which provided the mobility, and the seating system, which provided the postural support. At the same time that a shift from a conventional power wheelchair to a power-base wheelchair was taking place, significant advancements were occurring in electronic systems. Some of those mechanical and electrical advancements included the ability to add power tilt and recline systems and programmable performance settings (e.g., forward speed, turning speed, and acceleration).

Joysticks, the most basic and common devices used to control electric wheelchairs, came to resemble those used with computer game consoles.

Fig.2: Electric Powered Wheelchair

3. DESIGN OF WHEELCHAIR SYSTEM

The construction of the smart wheelchair is basically categorized in two sections, hardware and software. The Hardware implementation includes interfacing dual motor driver with PIC16F887, GSM module, ultrasonic sensor along with RF receiver. The Software implementation emphasis on programming

the PIC microcontroller through MPLAB®X IDE, designing of GUI display using KEIL µvision5 and STM32F429 libraries.

3.1 Hardware Implimentation

Four motors are interfaced with controller with help of motor driver. 12v battery supply is given to duel motor driver. Duel motor driver based on H Bridge controls the movement of motor which are connected with wheelchair enable to move wheel chair forward backward left and right direction.

The wheelchair users are also facilitated with wireless communication for emergency situation. The Intelligent wheelchair is developed as a very low cost product. It is designed as an embedded system and is directly usable; it does not require a laptop or other heavy devices as compared to the sophisticated wheelchair products available today. Hence it proves to be ideal solution for physically disabled and elderly people.

In the situation where no of disabled and handicapped are aggravating with war and aging, this product has great timely value. It also contains obstacle detection techniques with the help of IR sensor. This allows the use of wheelchair for disabled person to lower the cost and improve effectiveness.

The wheel chair that runs by means of Electric motor is known as electric-powered wheelchair, this wheel chair requires navigational controls, usually a small joystick mounted on the armrest.

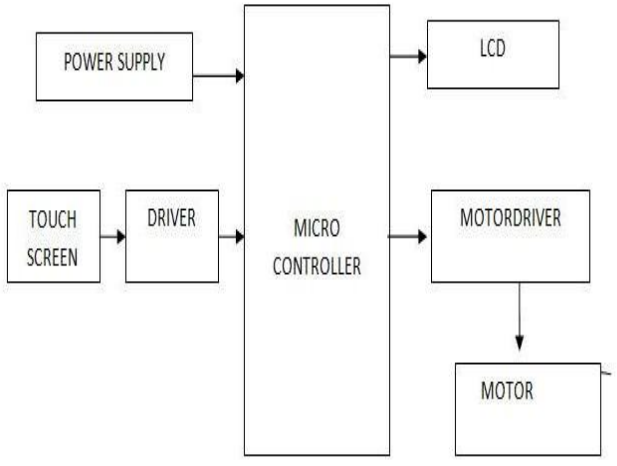

Fig.3: Block Diagram of Multifuctional Wheeelchair System

The wheelchair users are also facilitated with wireless communication for emergency situation. The Intelligent wheelchair is developed as a very low cost product. It is designed as an embedded system and is directly usable; it does not require a laptop or other heavy devices as compared to the sophisticated wheelchair products available today. Hence it proves to be ideal solution for physically disabled and elderly people. In the situation where no of disabled and handicapped are aggravating with war and aging, this product has great timely value.

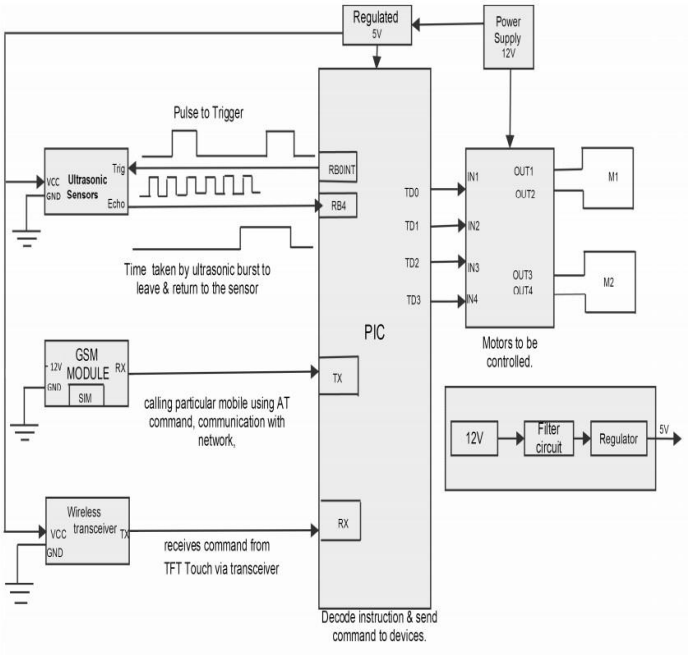

Fig.4: Block Diagram of Reciever Section of Wheelchair

To accommodate this population, several researchers have used technologies originally developed for mobile robots to create “smart wheelchairs.” A smart wheelchair typically consists of either a standard power wheelchair base to which a computer and a collection of sensors have been added or a mobile robot base to which a seat has been attached. It is worthy to recall that the aim of this study was to develop an intelligent robotic wheelchair to provide independent mobility to cognitively and motor disabled people.

Motorized wheelchairs are useful for those unable to propel manually or who require travelling for a long distance which creates difficulty for manual operation. These wheel chairs are not only used by traditional mobility impairments but also by cardiovascular patients.

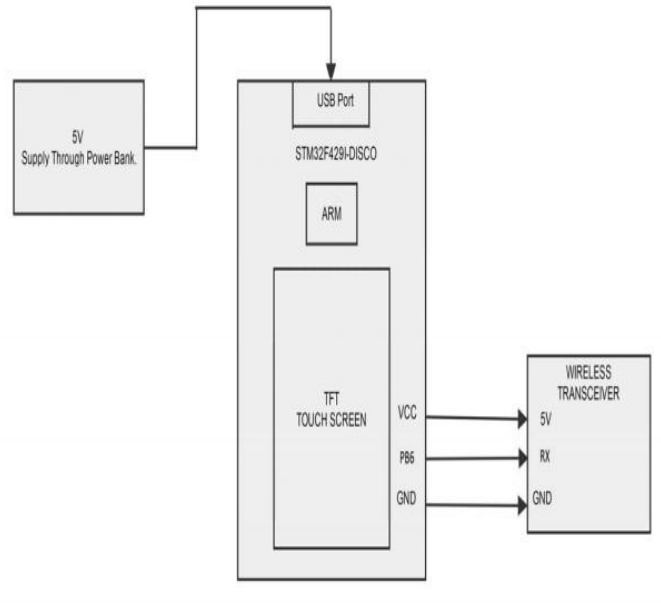

Fig.5: Block Diagram of Transmitter Section of Wheelchair

The design of wheel chair started by means of literature review to know its evaluation from earlier to the present generation. Market study was carried out to know the present competators available in the market with cost analysis of the existing product. Ethnography study was done to observe the need, the importance of the existing product and to address the design gap in the existing product to the user need through questionnaries. The feed back was taken from different users and attendees, concept generation and design execution was done by the implementation of design methodologies like Quality Function Deployment, Mind mapping, Product Design Specification.

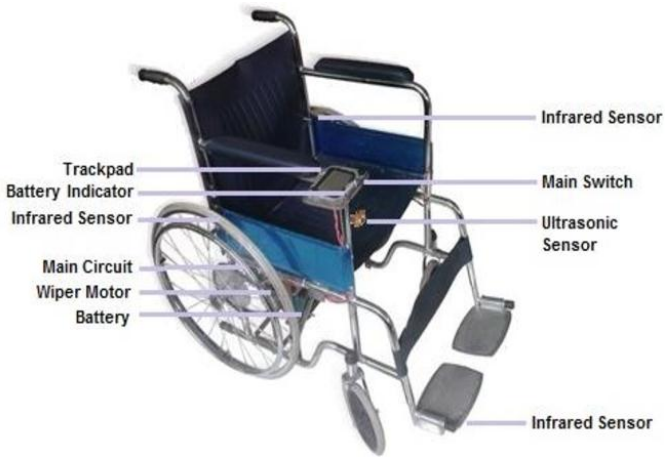

Fig.6: Touch pad Operated Wheelchair

3.2 Software Design

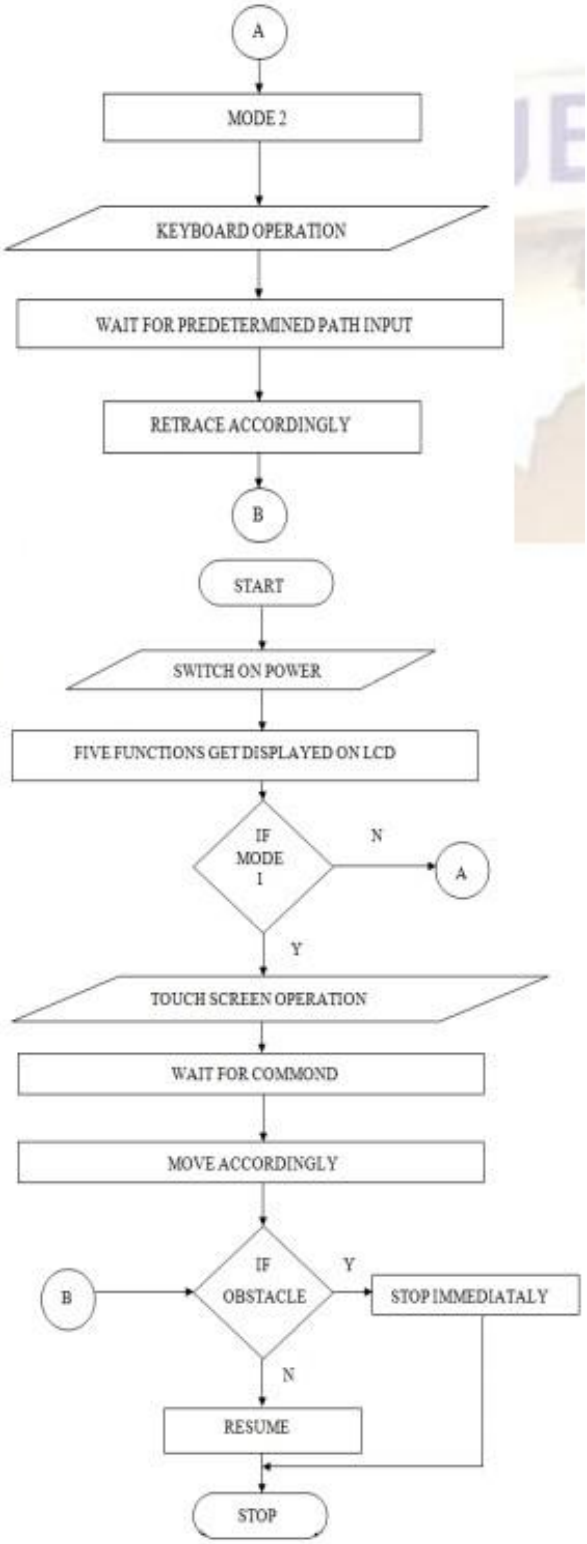

Fig.7: Flow chart of wheelchair system

Software design enables the adaptive changes in the system without changing the hardware as per patient's requirement. Some additional facilities can be added with the help of software. Patients with

cognitive disorder require different arrangement than elderly patients.

A) ALGORITHM

1) start

2) Turn on power

3) Give command on touch screen panel

4) Choose navigation option as per indoor or outdoor environment.

5) Avoiding obstacles automatically through sensors

6) Reach destination

7) Stop

4. CONSTRUCTION AND DESIGN

4.1 Obstacle Avoidance System

In this work hc-sr04 ultrasonic sensor is implemented, it provides trig and echo pin for interfacing with any microcontroller. With the help of PIC we have sent pulses to trig pin to take measurement, with help of pulse, sensor will able to send ultrasonic waves. It will come back to the sensor whenever obstacle is detected in permissible region. We require defining pins and by using TRIS register in PIC will set TRIG pin as output and echo pin as input. Our target is creating function which will send pulse to trigger pin, with the help of timer we can measure time by using start timer and find rising edge on echo line whist will stop timer when we get falling edge. Using this method we are able to find out length of pulse in microseconds. By using time and distance relation formula we are able to calculate distance of obstacle from wheelchair.

We can manually set the distance as much we needed.

4.2 .Design Of Touch Pannel

We have chosen touch screen over button and switches because of less requirement of external pressure and provides GUI interfaces. It is 4 wire resistive touch screen, as we touch particular area on touch screen it will create resistance difference between x and y layers and based on it the position of touch can be decided that can be measured by applying 5v dc to two ends of wires and measuring output voltage with A/D converter and digital signal will be received by microcontroller unit.

STM32F429 discovery board has inbuilt 2.4'' QVGA TFT LCD with resolution of 240*320 and works based on ARM processor. Touch screen is two dimensional device thereby touch digitizer coordinate system is used. In portrait orientation, origin starts at upper left corner, with X as horizontal and y as vertical. Code is created using KEIL µvision5 for designing of GUI display and Reading X, Y positions from touch screen. Code is designed for STM32F429ZIT6 controller. Have created different functions using libraries available for stm32 created function will wait for touch operation and when particular button on touch screen is pressed, it returns X,Y co-ordinate respectively.

4.3 Emergency Alert System

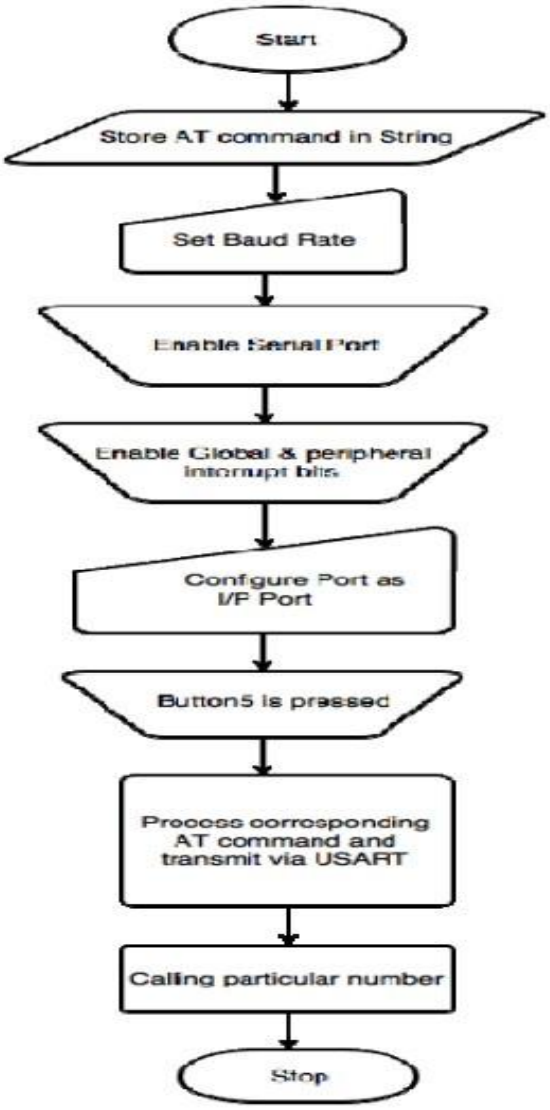

Fig.8: Flowchart of Emergency calling system

The merit of using GSM module is we can directly interface it with PIC controller without introducing any line converter to control rs232logic to TTL output. AT command is used to access data and configuration with respect to mobile devices, SIM cards and modem.

Using the PUGH method, concepts are analyzed for various parameters of each model against the fixed rating for each parameter, its pluses and minuses in terms of its usability, performance, unique features, etc are counted. Based on the overall rating, concept is selected as final trolley design.

For Emergency calling we are using second generation mobile technology global system for mobile (GSM). GSM module is interfaced with PIC16F877A to dial a particular mobile number using AT command in Emergency situation.

5. Implimentation Of Designed System

Fig.9: Developed wheel chair

After the generation of concepts, the sketching and rendered images of different types along with depiction to understand the working principles were prepared. A total of 5 concepts were generated.

These were explained to various people in the community. Based on the explanation and their understanding of the concept through these images, various feedbacks were collected from them. The feedbacks were analyzed and categorized according to design parameters through which the pros and cons of each concept were studied and the best concept for chosen for this study by PUGH method.

Four fundamental requirements for self-governing operations for people with motor-impairments are Mobility, Ambient control, Health monitoring and emergency handling stands vital for transitioning to living independently.

Fig.10: Touch Pad of Wheelchair

6. ADVANTAGE

i. Highly user friendly

ii. Easy to design and manufacture

iii. Highly portable

iv. Less wire complexion

7. DISADVANTAGE

i. Stress on human finger for large use

ii. Absence of auto braking mechanism

8. FUTURE WORK

Much future work is to be completed before commercialization of this project. This includes further development of hardware and software. It also includes the full testing of the system. The system can be redesigned and rebuild as per the patients requirement.Future work will focuses on valid implementation of Anti-breaking system and Emergencybreaking system.

Many factors like the weight of the user, the age of the batteries, and the type of terrain being travelled can influence the battery range, henceforth future work prioritizes on enhancing functionalities which will allow to move them without much interaction from user making it more autonomous. We have

planned wide range of activities that will be useful to evaluate system.

9. CONCLUSIONS

We have described the system which is driven by the sensors and advanced algorithm. Though we are mainly focusing on touch screen based system interface, further advancements can be done through more research. The interface and software can be modified and redeveloped according to the level of disability of the patient.

This proposed embedded system solution is not limited to wheelchair implementation instead it can be further modified and elevated to varied robotic vision development.

10. ACKNOWLEDGEMENT

We take this opportunity to express our gratitude and indebtedness to our guide and H.o.D. prof. K. B. Nagne, Electrical (E & P) Department , who is a constant source of guidance and inspiration inn preparing this work.

We express our sincere gratitude towards Assistant Professor whose constant help and encouragement helped us to complete our project report. We are grateful to Dr. L. P. Dhamande, Principal for his encouragemnet and support.

REFERENCES

[1] Aye Aye Nwe, Wai Phyo Aung and Yin Mon Myint,'Software Implementation of Obstacle Detection and Avoidance System for Wheeled Mobile Robot', World Academy of Science, Engineering and Technology 42 2008

[2] "Embedded Systems “By Raj Kamal, Publication: Tata McGraw-Hill Education, 2008

[3]Embedded Systems: Introduction to Arm(r) Cortex -M Microcontrollers, by Jonathan W Valvano

[4] M.Prathyusha, K. S. Roy , Mahaboob Ali Shaik, Dept. of E.C.E, K. L. University Guntur, India, Voice and Touch Screen Based Direction and Speed Control of Wheel Chair for Physically Challenged Using Arduino, International Journal of Engineering Trends and Technology (IJETT) - Volume4Issue4- April 2013 , ISSN: 2231-5381

[5]PIC Microcontrollers, mikroelektronika, By Milan Verle,1st edition(2008), ISBN-13: 978-86-84417-15-4

[6] Soniya D. Makwana, Prof Anuradha G. Tandon Dept. of Instrumentation and control Institude of technology, Nirma Univercuty Ahmedabad, india “Touch Screen Based wireless multifunctional wheelchair using ARM and PIC Microcontroller”2016

[7] Sayali Nerkar, Shweta Jadhav, Radhika Shouche, Sukanya Sonawani , " Android Based Vehicle Service Status Monitoring System" , International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering , Vol. 3, Issue 2, February 2014

[8] The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors, Third Edition 3rd Edition by Joseph Yiu

[9] “The Insiders Guide To The Philips ARM7-Based Microcontrollers” by Trevor Martin

[10]www.nxp.com/documents/data_sheet/LPC2141_42_44_ 46_48.pdf

[11]www.nxp.com/documents/user_manual/UM10139.pdf

[12] www.Coineltech.com › ARM7