Journal of Chemical and Pharmaceutical Sciences ISSN: 0974-2115

ALPHA-MINION BOTS WITH THERMAL IMAGING FACILITY FOR LEADING INTEGRATED HUMAN QUEST MISSIONS.

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ABSTRACT

In today's world, the possibility of humans working in disaster-prone areas such as earthquake, fire, blasts or radioactive war zones where repetitive search and report has to be done can be difficult or too dangerous. Thus, a robot can replace the human and do his work. Here we propose an idea known as the Master-slave technique to control a system of robots, The Alpha-Minion Bots which are fitted with thermal imaging and are interconnected through a wireless protocol. This is basically a multi-robot system that consists of a group of smaller robots that coordinate between themselves and complete a bigger task which will be impossible or inefficient with a single robot system.

Key Words: Master-Slave, Wireless Protocol, Thermal Imaging, Thermal Imaging, Alpha-minion Robots.

INTRODUCTION

This system of Robots will operate on a complete autonomous phase using a technique known as Master-Slave. The Master-Slave technique involves an alpha robot, which gives out the commands to its smaller robots, the minions. The Minion Robots are connected wirelessly to the Alpha Robot using an MIWI P2P wireless protocol, a low power industry based wireless network. The idea is to send the Alpha-minion Robots to any area which requires help, such as a Disaster-prone area or a radioactive zone where it might be too dangerous for humans to go help. The minions scan the disaster prone area which might have a lot of injured humans stuck in places that might be difficult for a human search party to fit through, according to the command issued by the alpha bot. They are fitted with a high speed camera and thermal imaging facilities that detects human signatures, due to the heat emitted from the body. After completion of the task, the alpha bot sends out the return command and the minions return back to the alpha using a methodology known as Radio Frequency Signal Strength Analysis. The Alpha Robot then carries the minions back to the base station where the scan results/photos can be viewed on a PC/Laptop by using the memory card in the camera. The Robots could run on smaller batteries as they don't have to travel long distances.

The development of the Alpha Robot is done on the LPC1764 ARM Cortex-M3 microcontroller platform and the Minions are developed using an LPC1313 platform. Figure 1 shows the LPC1764 ARM Cortex-M3 Alpha Unit and Figure 2 shows the LPC ARM Cortex-M3 Minion Unit. Both these Units are connected to MRF24J4MA Transceivers respectively.

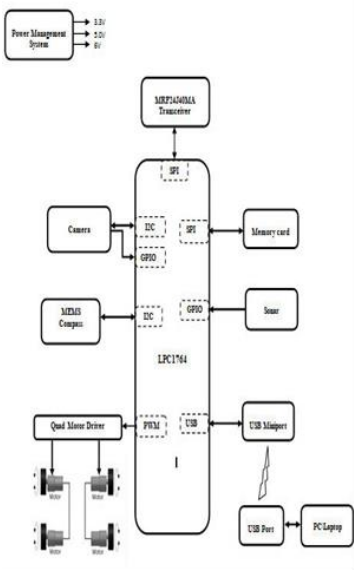


Figure1 Alpha Unit

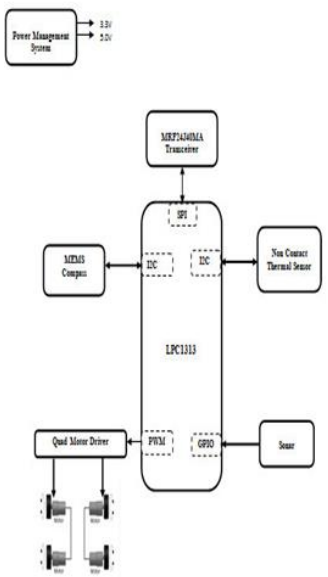


Figure2 Minion Unit

ARM CORTEX-M3: The ARM Cortex-M3 is a next generation core that offers system enhancements such as modernized debug features and a higher level of support block integration. The ARM Cortex processor has a standard architecture to address upon the broad performance spectrum required by their various technologies.

Journal of Chemical and Pharmaceutical Sciences ISSN: 0974-2115

The ARM Cortex family of processors provides a standard architecture to address the broad performance spectrum required by these diverse technologies. The ARM Cortex family includes processors based on the three distinct profiles of the ARMv7 architecture; the A profile for sophisticated, high-end applications running open and complex operating systems; the R profile for real-time systems; and the M profile optimized for cost-sensitive and microcontroller applications.

The Cortex-M3 processor is the first ARM processor based on the ARMv7 architecture and has been specifically designed to achieve high system performance in power- and cost-sensitive embedded applications, such as microcontrollers, automotive body systems, industrial control systems and wireless networking, while significantly simplifying programmability to make the ARM Architecture an option for even the simplest applications.

LPC1764 ARM CORTEX-M3 Microcontroller: The LPC1764 is an ARM Cortex-M3 based microcontroller for embedded application requiring a high level of integration and low power dissipation.TheLPC1764 contains up to 512 kB of flash memory, 64 kB of data memory, Ethernet MAC, a USB interface that can be configured as either Host, Device, or OTG, 8 channel general purpose DMA controller, 4 UARTs, 2 CAN channels, 2 SSP controllers, SPI interface, 3 I2C interfaces, 2-input plus 2-output I2S interface, 8 channel 12-bit ADC, 10-bit DAC, motor control PWM, Quadrature Encoder interface, 4 general purpose timers, 6-output general purpose PWM, ultra-low power RTC with separate battery supply, and up to 70 general purpose I/O pins.

LPC1313 ARM CORTEX-M3 Microcontroller: The LPC1313 is a low power consuming ARM Cortex-M3 based microcontroller with a higher level of integration for embedded applications. The LPC1313 series consists up to 32 kB of flash memory, 8kB of data memory, a USB Device, one Fast-mode Plus (FM+) I2C interface, one UART, four general purpose timers, and up to 42 general purpose I/O pins.

MIWI P2P WIRELESS PROTOCOL: The Microchip Mi Wi P2P Wireless Protocol is a variation of IEEE 802.15.4, using Microchip's MRF24J40MA 2.4 GHz transceiver and any Microchip 8, 16 or 32-bit microcontroller with a Inter Integrated Circuit (I2C)., the protocol provides reliable direct wireless communication via an easy-to-use programming interface. It has a rich feature set that can be compiled in and out of the stack to meet a wide range of customer needs while minimizing the stack footprint.

The MIWI P2P protocol modifies the IEEE 802.15.4 specification's Media Access Control (MAC) layer by adding commands that simplify the handshaking process. It simplifies the link disconnection and channel hopping by providing supplementary MAC commands.

RESULTS AND CONCLUSIONS: The Robots have indeed been developed successfully as the movements are in order and fully autonomous. From observation that has been made, it clearly shows that its movement is precise and accurate. Figure3 (a) & (b) shows the physical implementation of the Robots, the Alpha and the Minion. Figure4 (c) & (d) shows the LPC1764 and LPC1313 Development Boards used.

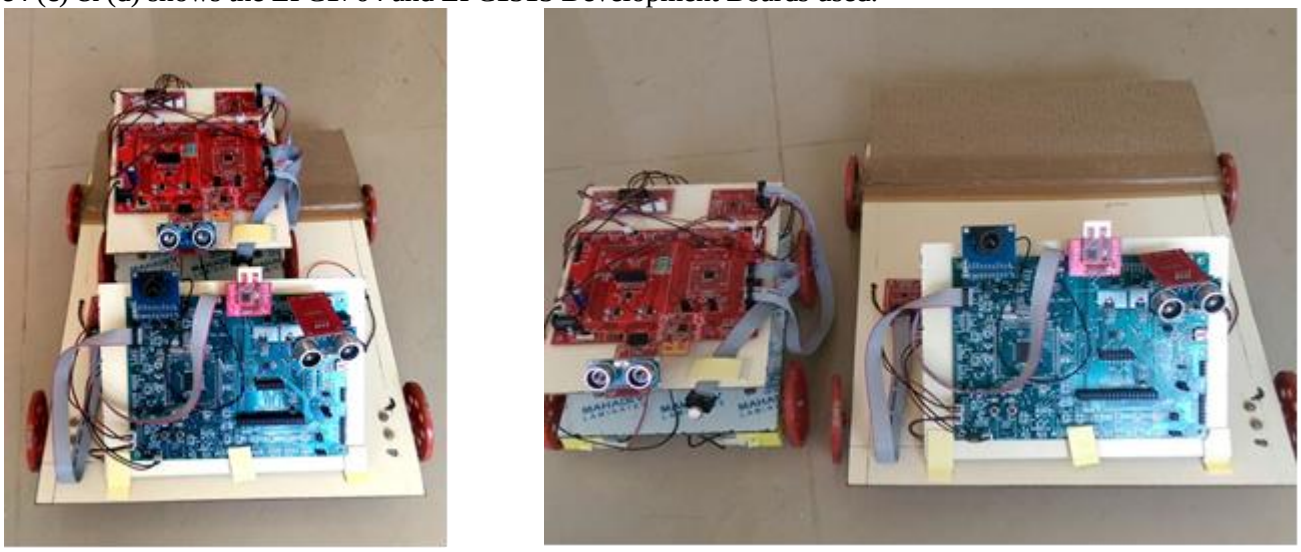
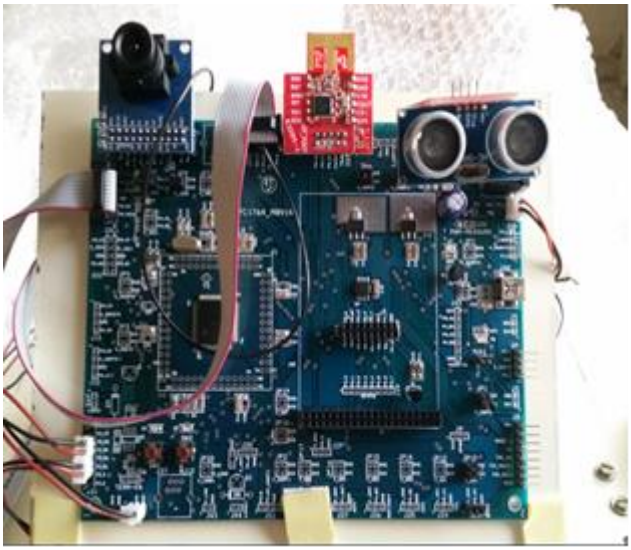


Figure3 (a) Physical Implentation of the Robots, (b) Minion Robot (left) and the Alpha Robot (Right)

Journal of Chemical and Pharmaceutical Sciences ISSN: 0974-2115



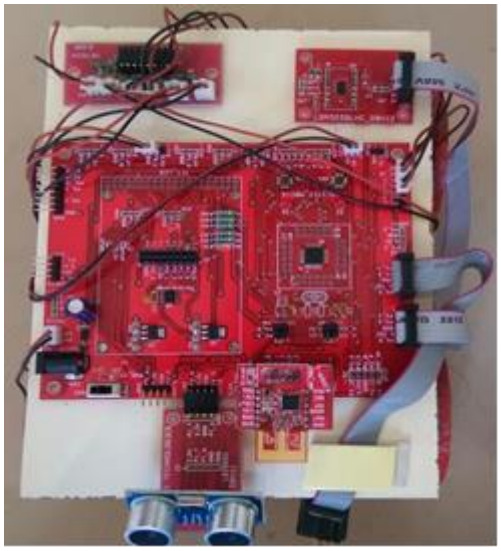


Figure4 (c) The LPC1764 development board, (d) The LPC1313 development board

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