

Design and Implementation of an Automated Unmanned Tanker Robot Using Bluetooth Module and Microcontrollers

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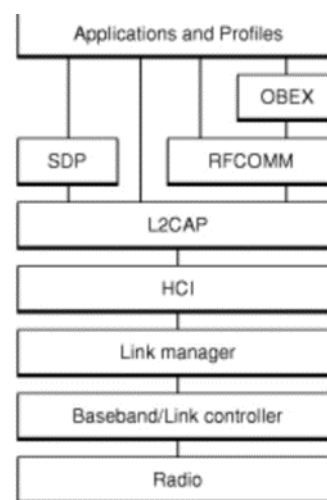
Abstract – A lot of research work is being done in the field of developing unmanned utility vehicles. These vehicles can be surface based or aerial. The unmanned technology is governed by the use of wireless technology developed by an RC circuit; however this technology has quite a few drawbacks which include limited frequency range and limited access or control. External factors also hinder the functioning of the RC circuits due to the sunlight interference with the signals. The use of wireless technology or Bluetooth module can overcome all these obstacles and provide us with the better working of the robots. The limitations can be overcome by using these technologies. There is no interference in these technologies with a wider range for operation of the unmanned robot. The presence of external factors does not affect the functioning of the technology. This paper provides us insight on the wireless and Bluetooth module technology which are used to send remote streams in order to control our unmanned tanker robot. It also includes the fabrication of a microcontroller circuit to control the unmanned robot. The practical use has certified it has friendly as well as accurate.

1. INTRODUCTION

Earlier technologies included the use of RF control which is also a type of wireless tech. which involves a hand held controlling device which was of good application to the military services etc. It is a human operated technology. IR signals are prominent in this technology which had the drawback of being hindered by the external factor such as barriers (physical), sunlight etc. Concluding that the RF technology was not beneficiary in many situations. Therefore in order to overcome the drawbacks of the RF circuit IR technology we have developed a prototype unmanned tanker robot using the Bluetooth Module and WIFI technology. All this has been realised by a Microcontroller circuit. Bluetooth technology is used for exchanging data over short distances using UHF radio waves in the ISM band from 2.4 to 2.485 GHz, from any device which is either fixed or mobile. Personal area networks (PANs) are the networks over which this technology functions. The Bluetooth technology operates in unlicensed industrial, scientific and medical 2.4 GHz short – range radio frequency band. Bluetooth uses a frequency-Hopping spread spectrum. Other technology used in the

working of our robot is the WIFI technology that uses radio waves to provide high speed internet and network connectivity.

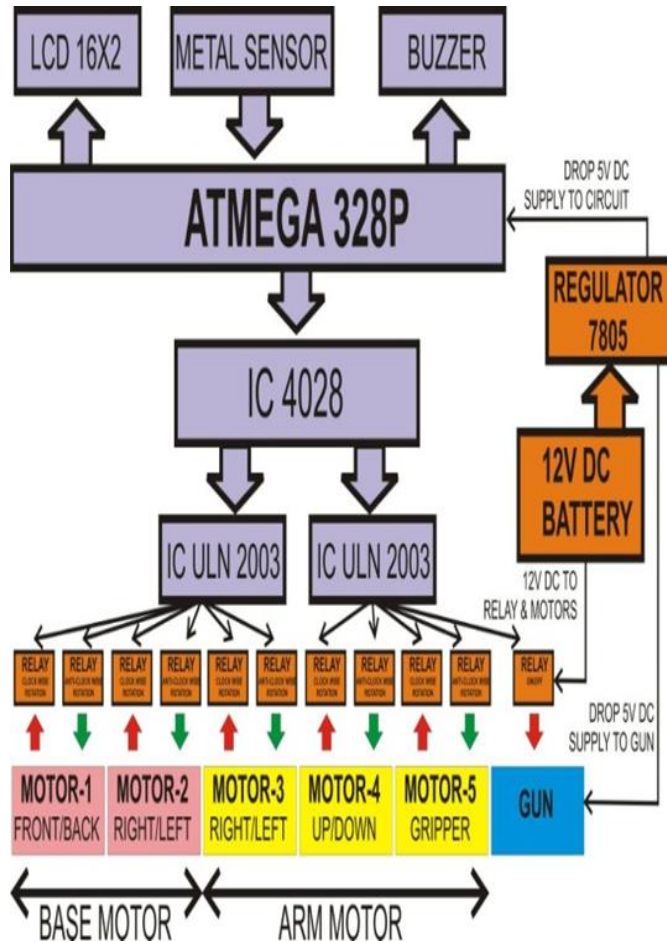
2. SYSTEM OVERVIEW



The diagram above explains the working system of the Bluetooth module. The unmanned robot will be controlled here by the cell phone that will operate through the use of application. The Bluetooth radio layer will be same as the physical layer of the OSI model. It will cause radio transmission as well as modulation. The application will communicate with the L2CAP via SDP, OBEX, and RFCOMM. These are the middle ware layer components. Next comes the data link layer which includes HCI and link manager. Below the link manager we have the baseband / link controller. The Bluetooth layers structure doesn't follow the OSI model, TCP/IP model etc. The last layer is the Physical Layer also called as the radio layer. The radio layer will transfer the data from the master to slave. The power system is low and uses the 2.4GHz ISM band in a range of 10 meters. This final band consists of 79 channels each having 1MHz range. Bluetooth will hop 1600 times in a second for the modulation. We use GFSK i.e. FSK with Gaussian bandwidth filtering to convert the bits into signals. Bluetooth uses a form of TDMA i.e. TIME DIVISION MULTIPLEXING which is half duplex i.e. The receiver can

send and receive data but can't do it simultaneously. L2CAP performs multiplexing at sender side and demultiplexing at the receivers' end. It stands for Logical Link, Control adaptation Protocol Layer.

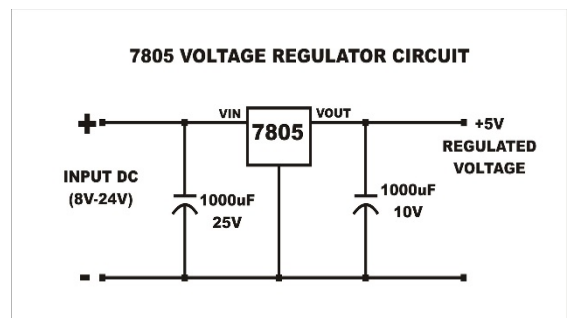
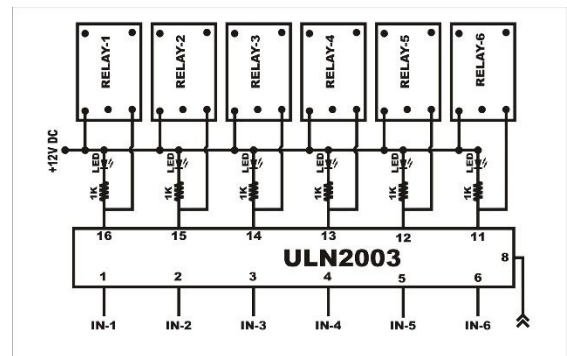
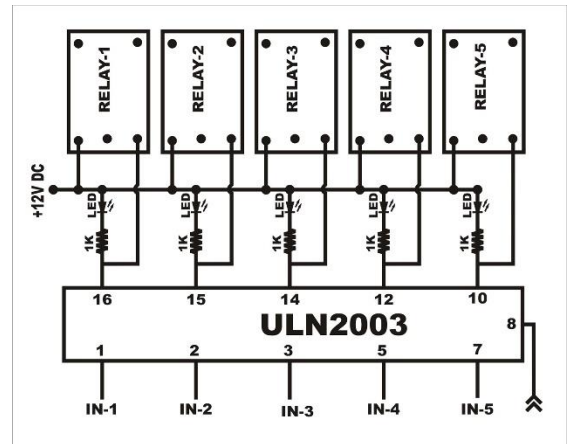
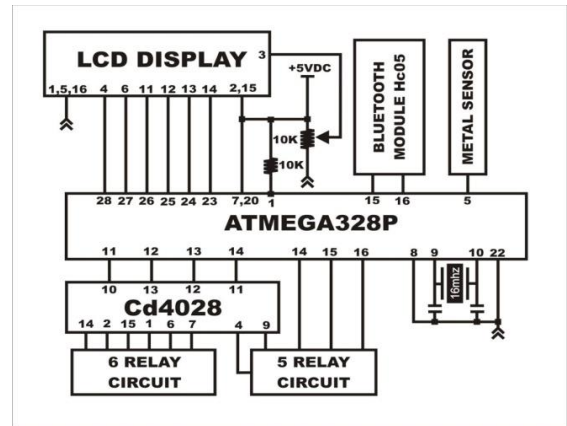
FUNCTIONAL BLOCK DIAGRAM



The block diagram explains the hardware components of the unmanned tanker robot. We have an LCD of the 16 by 2 dimensions which is fed the output by the main Micro controller i.e. ATMEGA 328P. The buzzer also receives the output from this micro controller. ATMEGA 328P feeds the output to the IC 4028 which provides a divided output to both IC ULN 2003. Metal sensor also feeds the output to ATMEGA 328P.

There are 2 relay circuits to control the movement of arm as well as the wheels of the robot. 5 Motor circuits are provided to facilitate good movement of the robot. 2 motors are Base motors and the remaining 3 motors are the Arm Motor. The gun for the robot is provided with a 7805 regulator which in turn is fed by a 12V DC Battery. After the regulator does its functioning a 5V DC Current is fed to the ATMEGA 328P.

CIRCUIT DIAGRAMS



Construction

The circuit consists of microcontroller ATmega328/p and a Bluetooth module, powered by a 12v battery. The Unmanned Tanker is consisting of 11 relay circuits, six for movement of the tanker and five for movement of attached arm. The motion of the robot as well as the arm is Bluetooth controlled. ATmega328/p is used to link hardware of the system to the software and provides low power consumption versus system performance. The microcontroller is attached to a metal detector which produces a 'beep', as soon as any metal is detected. To the movable arm, is attached a laser gun along with a Wi-Fi camera. The Wi-Fi camera provides visibility of the Tanker's path of motion. The Wi-Fi camera is paired using a software and assists in aiming as well as motion control facilities of the unmanned robot. To the circuit, is attached a LCD display which shows the operation mode of the Tanker. When the Bluetooth system is used for the movement of Tanker, the LCD screen displays 'ROBOT'.

Whereas when the Bluetooth system is used to control the Tanker's ARM movement or CLUTCHER system, the LCD screens displays 'HAND'. The motion is made possible with the help of a Motor system. Motors are fixed to the bottom of this steel chassis and the circuit is affixed firmly on top of this chassis. A cell phone is also mounted on the chassis. In the four-wheel drive system, the two motors on a side are controlled independently of each other. The software is written in 'C' language and compiled using AVR Studio 6.0 'C' compiler. The source program is converted into hex code by the compiler and burned into ATmega328/p microcontroller.

3. MAIN HARDWARE COMPONENTS

1. ATMEGA 328P

Atmega328/P is a low power CMOS 8-bit microcontroller based on RISC architecture with enhanced AVR, where instruction execution occurs in a single clock cycle. It achieves throughputs close to 1MIPS per MHz; this enables system designers to optimize the device for low power consumption versus the processing speed.

1.1 FEATURES:

ATmega 328/P offers high system performance for low power consumption.

Instruction set available in ATmega 328/P are powerful and possess an advanced architecture.

It also provides a high endurance memory segment, which is non volatile in nature.

It has 1KB of ROM and 2 KB of Internal RAM, data retention of 20 years at 85°C and 100 years at 25°C.

It's peripheral features includes two 8 bit Timer with separate Pre Scaling and Comparison modes and another 16 bit Timer/Counter with separate Pre Scaling and Comparison modes.

Other special features offered by ATmega 328/P are Power On Reset and Brown Out Detection.

It has six Sleep Modes, namely Idle, ADC, Noise Reduction, Power Saver, Power Down and Standby mode.

2. BLUETOOTH MODULE:

2.1 COMPONENTS:

HC serial Bluetooth consist of Bluetooth serial interface module and Bluetooth adapter, such as:

(1) Bluetooth serial interface module:

Industrial level: HC-03, HC-04(HC-04-M, HC-04-S) Civil level: HC-05, HC-06(HC-06-M, HC-06-S)

HC-05-D, HC-06-D (with baseboard, for test and evaluation)

(2) Bluetooth adapter:

HC-M4

HC-M6

2.2 FUNCTION & CONFIGURATION:

Bluetooth serial module replaces the serial port lines, such as:

1. If two MCUs want to communicate with each other. One device is connected to the master Bluetooth device while the other is connected to the slave device. Their connection is built through pairing, and then is linked to a serial port connection including RXD, TXD signal, making the serial module usable for communication.

2. When MCU communicates with Bluetooth adapter of computers and smart phones through a slave module, there is a virtual communicable serial port line between MCU and Computer or smart phone.

3. The Bluetooth devices in the market mostly are slave devices, such as Bluetooth printer, Bluetooth GPS. So, we can use master module to make pair and communicate with them. Bluetooth Serial module's operation doesn't need drive, and can communicate with the other Bluetooth device that has the serial. But communication between two Bluetooth modules requires at least two conditions: The communication must be between master and slave & the password must be correct.

4. APPLICATIONS

A .MILITARY APPLICATIONS

The unmanned tanker robot has a wide range of application and the primary of these applications is for the military purpose. Every day we see or hear news of devastation caused due to conflicts in war stricken countries, numerous lives of the soldiers at stake with countless soldiers being martyred each

day. Selfless service to the nation as well as its citizens is the sole objective of every soldier and in an effort to save the lives of our brave soldiers on the lines of our nation our project will serve as the perfect prototype to safeguard the lives of our soldiers by sending in robots to the battlefield which will be operated by our soldiers at a far away distance which will keep them away from harm. Soldiers losing their lives on the lines of control, in case of terrorist invasions etc is a serious issue and we have tried to create an innovation which will safeguard our brave countrymen.

B. CURB ANIMAL POACHING

A large number of animal species which have been living with absolute peace and harmony with us on our planet Earth are on a verge of extinction. This is really sad and devastating reality of today's times. The great Bengal tiger, the snow leopard, black buck are on a verge of extinction all because of these inhuman and unscrupulous human acts of poaching and killing these innocent animals. Birds such as kiwi have been long extinct due to these acts of poaching which weren't stopped at an appropriate time. The government although has safeguarded the animals of our country however the illegal acts of poaching still goes on in our forests causing harm to our innocent animals their families as well as our eco system. Our tanker robot can serve as the perfect aid to our animals, these tankers can be sent on into the forests during both day as well as night time, identifying human presence through sensors of heat signatures as well as 360 degree live cam output through which any hunter or poacher can be put down using tranquilizers and anything of that sort to protect the animals from attacks. The tank robot being a small prototype would be perfect to canter in the forest serving as a forest guard and protecting the innocent wildlife and maintaining harmony and ecosystem in our forests and our nation.

C. SEARCH & RESCUE

The unmanned tanker robot can be utilised as a search and rescue robot due to its grabbing apparatus which has been employed in the robot. The robot has been given with a heat signature detection apparatus which can identify the presence of a body trapped under debris, snow or anything of this sort. The rescue operation can be carried out in most of the areas which may be inaccessible to humans or other rescue procedures might not work in any case. The gripper apparatus will enable rescuing of lives from far distances above the target to be rescued.

D. SECURITY PURPOSES

The unmanned tanker robot can be employed in various areas which require high security and prevent access to any one. In case of jeweller shops which require a watch 24 by 7 will benefit from the tanker robot as it will detect the presence of any thief or burglar automatically and sound off an alarm, strike with a tranquilizer, or anything of that sorts. Hence this could

prevent thefts from taking place and save everyone a lot of money. The tanker robot can be operated from a far off place manually. This will in turn save a lot of time effort as well as money in the long run.

5. FUTURE SCOPE

The design procedure of our unmanned tanker robot can be further upgraded by the use of IR sensors, laser technology. The robot can be upgraded any time with the use of advanced arsenal to demolish enemy threat of any sorts. IR sensors will have a better range and can detect the presence of enemy or any foreign object which is present beyond the line of sight of the person operating the robot. The robot can also be personalized by the use of applying privacy options to the robot by password protecting it in case of ensuring privacy and not allowing any external factor to influence the working of the robot. This will make sure that the robot is not misused in case of any outsider trying to use it via unethical means. The robot will also be needed to be safeguarded from hacking issues.

6. CONCLUSION

The development of our unmanned tanker robot has allowed us to overcome the drawbacks of using RF Circuit technology. Our robot has the advantages of having robust control, operating area is large, and interference has been minimised. The motion of the tank robot is controlled by the use of few simple commands. All the other functions of the robot are also governed by the use of few simple commands. The circuit is not much complex and is quite easy to understand due to a better human machine interface. The cost of appliances and equipments is not much considering the advantages and uses of the automated robot. The handling of the unmanned tanker robot doesn't require much skill on part of the operator. An ordinary person can manoeuvre the robot without having much knowledge of the circuitry. This will also prevent the cost of training people to operate the robot.

REFERENCES

- [1] S. L. Kim, W. Burgard, D. Kim, "Wireless Communications in Networked Robotics", *IEEE Wireless Commun.*, vol. 16, no. 1, pp. 4-5, Feb. 2009.
- [2] Akkaya, F. Senela, B. McLaughlin, "Clustering of Wireless Sensor and Actor Networks Based on Sensor Distribution and Connectivity", *J. Parallel and Distrib. Comp.*, vol. 69, no. 6, pp. 573-87, June 2009.
- [3] X. Li, N. Santoro, I. Stojmenovic, "Localized Distance-Sensitive Service Discovery in Wireless Sensor and Actor Networks", *IEEE Trans. Computers*, vol. 58, no. 9, pp. 1275-88, Sep. 2009.
- [4] B. Gerkey, M. Mataric, "A Formal Analysis and Taxonomy of Task Allocation in Multi-Robot Systems", *Int'l. J. Robotics Research*, vol. 23, no. 9, pp. 939-54, Sep. 2004.
- [5] Dr. S. Bhargavi "Design of an Intelligent Combat Robot for War Field": *International Journal of Advance Computer Science and Application*, volume 2, no.8, 2011
- [6] I.E.M.D. Goonethileke, "Wireless RF Based Surveillance Robot Controlled via Computer": volume 7, Jan 2012.
- [7] Dhiraj Sing Patel, "Mobile Operated Spy Robot": *International Journal of Emerging Technology and Advance Engineering*, volume 3, special Issue 2, Jan 2013.

- [8] Pratush G. "GSM Controlled Topple Resistant Spy Robot" : IEEE Transaction 2013 no-978-0-7695_5146- 3/13.
- [9] Aishwarya Patil, "Haptic Robotic Arm Using Voice and Gesture Recognition": International Journal of Advanced Research in Computer and Communication Engineering, volume 2, issue 3, march 2013.
- [10] Sweta N, "Design and Implementation of Accelerometer Based Robot Motion and Speed Control with Obstacle Detection": International Journal of Science Engineering and Technology Research, volume 2, issue 3, march 2013.
- [11] Ankita Patel, "Touch Screen Controlled Multipurpose Spy Robot Using Zigbee": International Journal of Advanced Research in Computer Engineering and Technology (IJARCET), volume 3, issue 4, march 2014.
- [12] Kalyanee N. Kapadnis, "RF Based Spy Robot" :volume 4, issue 4, April 2014.
- [13] Dr. Shantanu K. Dixit, "Design and Implementation of e-surveillance Robot for Video Monitoring and Living Body Detection": International Journal of Scientific and Research Publication, volume 4, issue 4, April 2014, ISSN 2250-3153.
- [14] IEEEExplore <http://ieeexplore.ieee.org/search/searchresult>
- [15] B. Gerkey, M. Mataric, "A Formal Analysis and Taxonomy of Task Allocation in Multi-Robot Systems", *Int'l. J. Robotics Research*, vol. 23, no. 9, pp. 939-54, Sep. 2004.
- [16] S. Liu, T. Sun, C. Hung, , "Multi-Robot Task Allocation Based on Swarm Intelligence" in Multi-Robot Systems Trends and Development, InTech, pp. 393-408, 2011.
- [17] L. E. Parker, "ALLIANCE: An Architecture for Fault-Tolerant Multi-Robot Cooperation", *IEEE Trans. Robotics and Automation*, vol. 14, no. 2, pp. 220-40, Apr. 1998.
- [18] M. B. Dias, "Market-Based Multirobot Coordination: A Survey and Analysis", *Proc. IEEE*, vol. 94, no. 7, pp. 1257-70, 2006-July.
- [19] V. Malbasa, I. Mezei, I. Stojmenovic, "Communication Aspects of Coordination in Robot Wireless Sensor Networks", *IEEE Robotics and Automation Mag.*, vol. 17, no. 4, pp. 63-69, Dec. 2010.