

Vidyalankar Polytechnic

Vision

To achieve excellence in imparting technical education so as to meet the professional and societal needs.

Mission

- Developing technical skills by imparting knowledge and providing hands on experience.
- Creating an environment that nurtures ethics, leadership and team building.
- Providing industrial exposure for minimizing the gap between academics & industry.

Program: Electronics & Telecommunication Engineering (NBA Accredited)

Vision

To produce Electronics and Telecommunication engineers capable of effectively using technical knowledge and interpersonal skills to benefit the industry and society.

Mission

- Providing state of the art facilities and conducive environment enabling the students to sustain the challenges in the field of Electronics and Telecommunication.
- Educating the students to face the competitive world, develop leadership skills and to instill discipline and ethics.
- Promoting industry institute interaction.

Program Educational Objectives (PEOs):

- **PEO1: Core Competence:** To develop expertise amongst students to meet the needs of the employer by using mathematical foundation, electronic fundamentals and enable them to understand and solve engineering problems.
- **PEO2. Professionalism:** To inculcate life-long learning, codes of professional ethics and entrepreneurial mindset.
- **PEO3. Conducive Learning Environment:** To provide encouraging academic learning environment needed for a successful professional career so that students can become a noble soul and an asset to the society.

Program Specific Outcomes (PSOs): (What s/he will be able to do in the Electronics and Telecommunication engineering specific industry soon after the diploma programme)

PSO 1. Electronics and Telecommunication Systems: Maintain various types of Electronics and Telecommunication systems.

PSO 2. EDA Tools Usage: Use EDA tools to develop simple Electronics and Telecommunication engineering related circuits.

Program Outcomes (PO) given by NBA. (What s/he will be able to do at the entry point of industry soon after diploma programme)

PO1. Basic knowledge: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.

PO2. Discipline knowledge: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.

PO3. Experiments and practice: Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.

PO4. Engineering tools: Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.

PO5. The engineer and society: Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in field of Electronics and Telecommunication engineering.

PO6. Environment and sustainability: Apply Electronics and Telecommunication engineering solutions also for sustainable development practices in societal and environmental contexts.

PO7. Ethics: Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of Electronics and Telecommunication engineering.

PO8. Individual and team work: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

PO9. Communication: Communicate effectively in oral and written form.

PO10. Life-long learning: Engage in independent and life-long learning activities in the context of technological changes also in the Electronics and Telecommunication engineering and allied industry.

A Project Report on

SWARM ROBOTS

Submitted by

17201B0022:Sania Bandekar

Under the guidance of

Er. Anjum Mujawar

Head of the Department

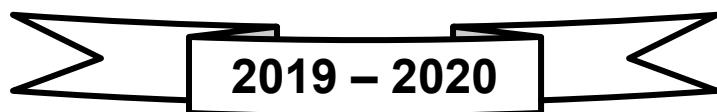
Er. Anjum Mujawar

**Department of Electronics & Telecommunication Engineering
(NBA Accredited)**



**Vidyalankar Polytechnic
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**Maharashtra State Board of Technical Education,
Mumbai**



Certificate

This is to certify that the following students

17201B0022:Sania Bandekar

Have completed the Project on

...27/05/20.....

A partial fulfillment of the requirement of Third Year Diploma in Electronics and Telecommunication Engineering affiliated to Maharashtra State Board of Technical Education, Mumbai for the Academic Year 2019-2020.

External Examiner

Project Guide

Er. Anjum Mujawar
(Head of Department)

Prof. Ashish Ukidve
(Principal)

ACKNOWLEDGEMENT

It is our pleasure to be indebted to various people, who directly or indirectly contributed in the development of this work and who influenced my thinking, behavior, and acts during the course of study.

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It is our great pleasure to express our gratitude to **Er. Anjum Mujawar**, Head of Electronics and Telecommunication Department for his kind support and valuable advice for this project work.

With immense pleasure and hearties, we express our sincere thanks to our project guide **Er. Guide name** his/her valuable suggestions and guidance.

We honestly express our ineptness to the teaching and non-teaching staff for their valuable guidance, help co-operation and continued encouragement in each and every step of this project till now.

Last but not the least; we are ineptness to our parents and siblings for their constant encouragement and support. And also all our classmates who were always there whenever help was required

Abstract

Famous inventor, Leonardo da Vinci's contributed the nose of the bullet train that was inspired from the beak of the kingfisher, resulting in more speed, energy efficiency and less noise as it passed through the tunnels; all of this summing up to a term coined as Biomimicry. Running parallel to the same, swarm intelligence emerged, promoting collective behavior of decentralized, self-organized systems, natural or artificial. Drawing reference, swarm robotics is a field of multi-robotics in which large number of robots are coordinated in a distributed and decentralized way. It is based on the use of local rules, and simple robots compared to the complexity of the task to achieve. Large number of simple robots can perform complex tasks in a more efficient way than a single robot using the transmission and reception modules of communication in electronics. Swarm intelligence claims historical underpinnings from both biology and engineering. Within a year, Beni had coined and popularized the term "swarm intelligence" in relation to robotics. He later identified a vague definition of the term swarm intelligence: "a property of systems of non-intelligent robots exhibiting collectively intelligent behavior". Reviewing the genesis and subsequent development of swarm intelligence research therefore requires approaching the subject from both entomology and robotics. Further looking up to this, it provides user friendly communication for personal assistance for the disabled and the young ones and creates bonding in fields where audience gets engaged with stage dramatics, theatre education and sci-fi based movies. The swarm robots comprises of, an obstacle avoider master robot and a blind slave robot. Master robots senses the environment and changes its direction; as this also poses a threat to the slave, it gets an alert to change the direction. Future could include: Swarmanoid, a heterogeneous swarm robotic system capable of operating in a fully 3-dimensional environment; Alice, a micro robot swarm. These cubical swarm robots form a bit huge army of 90 robots working together; Kilobots, self-assemble in a thousand-robot swarm. But if it was to argue about its application in military defense, then it would be - "The fiercest serpent may be overcome by a swarm of ants."

Keywords: Swarm Robotics, Future prospectus, Biomimicry, Swarm intelligence, Applications

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CHAPTER ONE

1.0 Introduction

Origins of Swarm-Based Robotics

In order to fully trace the intellectual heritage of swarm-based robotics, one must begin in the early 1970s. At that time, coordination and interaction of multiple agents were being studied in the field of distributed artificial intelligence (DAI), but investigations were limited to problems involving software agents. This tendency persisted until the late 1980s, when the robotics research community began to explore cooperative robotic systems. The earliest forays into cooperative robotics related to cellular (or reconfigurable) robotic systems, cyclic swarms, multi-robot motion planning, and primitive architectures for multi-robot cooperation. The first two of these topics eventually merged into the current field of swarm intelligence. Cellular robotic systems, such as CEBOT (CELLular roBOTs), were initially explored by Fukuda et al. CEBOT drew direct inspiration from biological organisms to generate an architecture based on decentralized hierarchies of robotic cells. Gerardo Beni started working on the same topic from a more theoretical perspective in 1988. Within a year, Beni had coined and popularized the term “swarm intelligence” in relation to robotics. He later identified a vague definition of the term swarm intelligence: “a property of systems of non-intelligent robots exhibiting collectively intelligent behavior”. The most precise definition provided by Beni was not a written verbal definition, but a mathematical construct is presented graphically in Figure 1. Note that the generalized definition (on the right) is less strict than the original, as it allows for systems to be termed swarm-intelligent by completing effective work, W , more efficiently than a non-cooperative group. Beni’s definition requires that the useful work in a given task can only be performed by N interacting agents, and only for N greater than a critical number, N_c .

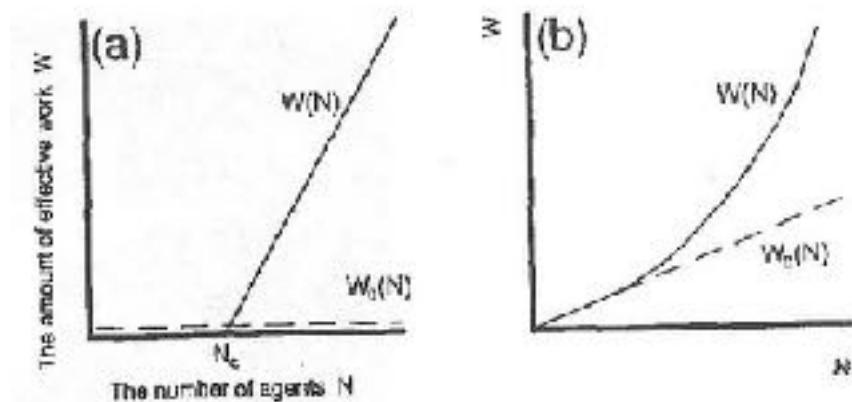


Figure 1. (a) Beni's definition of swarm intelligence (b) the generalized definition. $W(N)$ denotes the amount of work achieved by N interacting agents, and $W_0(N)$ denotes the work achieved by N

Deneubourg, Theraulaz, and Beckers, who study swarm intelligence from an ethological perspective, define a swarm as “...a set of (mobile) agents which are liable to communicate

directly or indirectly (by acting on their local environment) with each other, and which collectively carry out a distributed problem solving". These definitions conveniently avoid the problem of defining intelligence, although Deneubourg et al. imply that intelligence is somehow related to problem solving. The reader is referred to for a thorough discussion of robotic intelligence, the definition of which is debated philosophically as much as technically. Around the same time that cellular robotics research was taking shape, Rodney Brooks, from MIT's Artificial Intelligence Laboratory, published a groundbreaking paper in the still undeveloped field of cooperative robotics. In what has clearly become the most widely cited source in the swarm intelligence community, Brooks outlines a "robust layered control system for a mobile robot" known as subsumption architecture. Brooks' paper initiated the rapid progression of the behavior-based control movement. Combined with the inertia of cellular robotics and identified by Beni's terminology, swarm intelligence emerged in the early 1990s as a major component of mobile robotics research. Brooks and Beni provided the impetus for the emergence and rapid expansion of swarm intelligence as a research field. This is evidenced by the nearly omnipresent references to behavior-based control in the robotics literature. However, despite the rapid advance of swarm intelligence, a number of robot control architectures were developing simultaneously. Artificial intelligence is inspired from natural intelligence. It is abstracting natural intelligence continuously and implementing in machine artificially, example is robotics. Swarm robotics is a technique in which a group of Robots work in a synchronized and coordinated manner to complete a specific task in a team. Swarm Robotics is influenced by idea of swarm Intelligence and it implements the concept of natural swarms such as ant colonies, bee hives, flock of birds etc. The term "swarm" is used to refer a large group of locally interacting individuals with common goals". Swarm robotics systems are characterized by simplicity of individuals, local sensing and communication capabilities, parallelism in task execution, robustness, scalability, heterogeneousness, flexibility and decentralized control. To analyze potential capabilities of robot swarms, swarm robotics has been studied in the context of producing different collective behaviors to solve tasks such as: aggregation, pattern formation, self-assembly and morphogenesis, object clustering, and assembling construction, collective search and exploration, coordinated motion, collective transportation, self-deployment, foraging and others(for detail tasks of robot read paper). The analysis of the results of these studies show that robot swarms are capable to solve these tasks satisfactory in controlled laboratory environments , at the same time there is no evidence of applying swarm robotics to solve real-life problems. Swarm robotics has large domain of applications. It plays a vital role in solving real world complexities in significant way. Through our recent studies it is recognized that it is able to solve the problems and becoming closer to human needs. Although, it offers several advantages for robotic applications such as scalability, and robustness due to redundancy, few issues are also present here. It has an analogy far similar to that of humans. IR sensors behave like the human eye. 8 bit microcontroller acts as a processor to generate outputs via the IR sensor inputs. The DC motors act as the actuators which are the limbs. Numerous Advantages: Parallelism, Robustness, scalability, heterogeneousness, flexibility, cheap Alternative, stability, economical benefits. Challenges include: redundancy, lack of central control, no gesture based communications, cannot behave dynamically and it leads to deadlock of the whole system, cheap but high maintenance, can't respond to heterogeneous nature, identification and authentication, tracking, less proximity from the master, eavesdropping in communication.

CHAPTER TWO

2.0 Literature Survey

2.1 Kilobots

Today, most robots are designed to work by themselves, not as part of a team. Wyss researchers are developing robotic systems and algorithmic approaches to make artificial swarms of robots that collaboratively work together towards a common goal. In one licensed application of the technology, a collective of 1024 “Kilobots” (meaning “one thousand robots”) can be programmed to exhibit complex swarming behaviors, such as foraging and firefly-inspired synchronization, while a user can interact with the swarm as a whole (programming the robots, switching them on and off, etc.), no matter how many robots there are. Kilobot-inspired underwater swarming robots that use a novel vision system to coordinate movement like schools of fish are also being developed. The Kilobot technology has been licensed to K-Team Corporation for research and educational applications as a platform for collective swarm algorithms in hardware rather than merely computer simulations. Beyond this, a hive “operating system” could let a user program colonies of robots to perform complex tasks in natural environments such as land, air, and sea. Flying microrobots could be instructed to pollinate a field, or — inspired by mound-building termites — an autonomous robot construction team could be programmed to build 3D structures and traversable surfaces, to stack sandbags along vulnerable coastlines before a hurricane, or to lay out barriers around toxic chemical spills. Towards these goals, Wyss researchers have developed cutting-edge sensor technology, micro-actuators, and robust controllers allowing the robots to adapt quickly to changing conditions.

2.2 University of Sheffield

Researchers in the Sheffield Centre for Robotics, jointly established by the University of Sheffield and Sheffield Hallam University, have been working to program a group of 40 robots, and say the ability to control robot swarms could prove hugely beneficial in a range of contexts, from military to medical. The researchers have demonstrated that the swarm can carry out simple fetching and carrying tasks, by grouping around an object and working together to push it across a surface. The robots can also group themselves together into a single cluster after being scattered across a room, and organize themselves by order of priority. Dr Roderich Gross, head of the Natural Robotics Lab, in the Department of Automatic Control and Systems Engineering at the University of Sheffield, says swarming robots could have important roles to play in the future of micromedicine, as ‘nanobots’ are developed for non-invasive treatment of humans. On a larger scale, they could play a part in military, or search and rescue operations, acting together in areas where it would be too dangerous or impractical for humans to go. In industry too, robot swarms could be put to use, improving manufacturing processes and workplace safety. The programming that the University of Sheffield team has developed to control the robots is deceptively simple. For

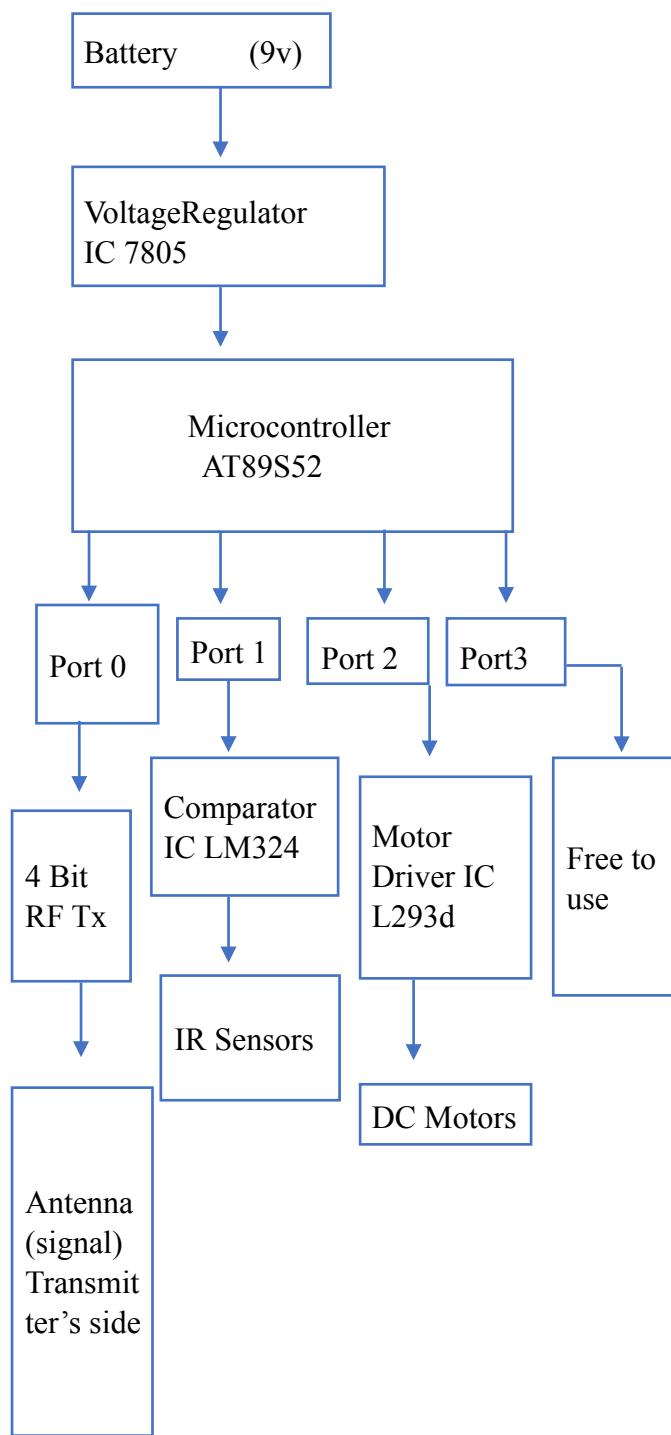
example, if the robots are being asked to group together, each robot only needs to be able to work out if there is another robot in front of it. If there is, it turns on the spot; if there isn't, it moves in a wider circle until it finds one. Dr Gross said: "We are developing Artificial Intelligence to control robots in a variety of ways. The key is to work out what is the minimum amount of information needed by the robot to accomplish its task. That's important because it means the robot may not need any memory, and possibly not even a processing unit, so this technology could work for nanoscale robots, for example in medical applications." This research is funded by a Marie Curie European Reintegration Grant within the 7th European Community Framework Programme. Additional support has been provided by the Engineering and Physical Sciences Research Council. The robots were showcased on Channel 5's The Gadget Show this week and will be demonstrated at this year's Gadget Show Live, to be held at the NEC in Birmingham from 3-7 April 2013.

CHAPTER THREE

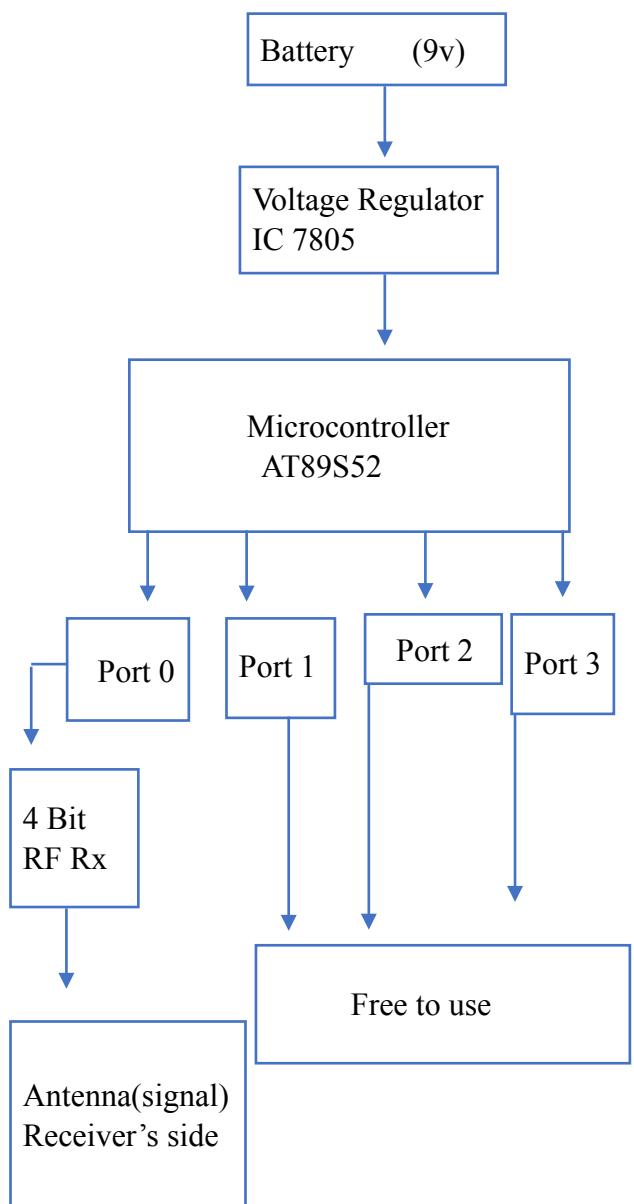
3.0 Block Diagram

Swarm robots

Obstacle Avoider Master



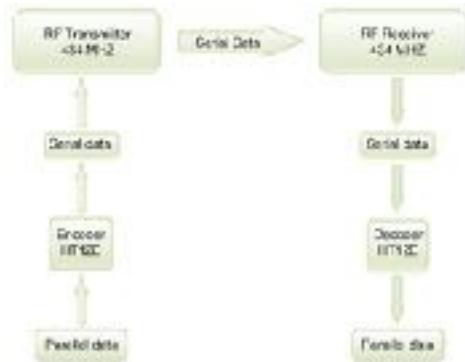
Blind Slave



3.1 Block Diagram Description

- 1) Battery- 9 volts batteries are used in this project. There are two motors, each requiring 9 volts supply. To power up the development board, another battery of 9 volts is used. The voltage provided by batteries are typically 1.2V, 3.7V, 9V and 12V. This is good for circuits whose voltage requirements are in that range. But, most of the TTL IC's work on 5V logic and hence we need a mechanism to provide a consistent 5V Supply.
- 2) Voltage Regulator IC 7805- It is an IC in the 78XX family of linear voltage regulators that produce a regulated 5V as output. The best alternative to using Batteries is to provide an unregulated but rectified DC Voltage from an AC Source. Since AC Source is easily available as mains supply, we can design a circuit to convert AC Mains to DC and provide it as input to the 7805 Voltage regulator IC. The AC power supply from mains first gets converted into an unregulated DC and then into a constant regulated DC with the help of this circuit. The circuit is made up of transformer, bridge rectifier made up from diodes, linear voltage regulator 7805 and capacitors.
- 3) Microcontroller- The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 instruction set and pinout.
- 4) Port 0- Port 0 is an 8-bit open drain bidirectional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high-impedance inputs. Port 0 can also be configured to be the multiplexed low-order address/data bus during accesses to external program and data memory. In this mode, P0 has internal pull-ups. Port 0 also receives the code bytes during Flash programming and outputs the code bytes during program verification. External pull-ups are required during program verification. In the master and slave, AD0 to AD3 are the address and data busses connected to 4 bit RF Tx and 4 bit RF Rx module respectively from B0 to B3.
- 5) Port 1- An 8-bit bidirectional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins, they are pulled high by the internal pull-ups and can be used as inputs. In master, it is connected to the LM324 comparator. It is kept as free to use in the slave.
- 6) Port 2 - An 8-bit bidirectional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the internal pull-ups and can be used as inputs. In the master, it is connected to motor driver. It is kept as free to use in the slave.
- 7) Port 3- An 8-bit bidirectional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull-ups. Port 3 receives some control

signals for Flash programming and verification. It is kept as free to use in the master and slave.



8) 4 Bit RF Tx and 4 Bit RF Rx - This includes RF transmitter module, HT12E Encoder and Antenna. This radio frequency (RF) transmission system employs Amplitude Shift Keying (ASK) with transmitter/receiver (Tx/Rx) pair operating at 434 MHz. The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission. The system allows one way communication between two nodes, namely, transmission and reception. The RF module has been used in conjunction with a set of four channel encoder/decoder ICs. Here HT12E & HT12D have been used as encoder and decoder respectively. The encoder converts the parallel inputs (from the remote switches) into serial set of signals. These signals are serially transferred through RF to the reception point. The decoder is used after the RF receiver to decode the serial format and retrieve the original signals as outputs. These outputs can be observed on corresponding LEDs. Encoder IC (HT12E) receives parallel data in the form of address bits and control bits. The control signals from remote switches along with 8 address bits constitute a set of 12 parallel signals.

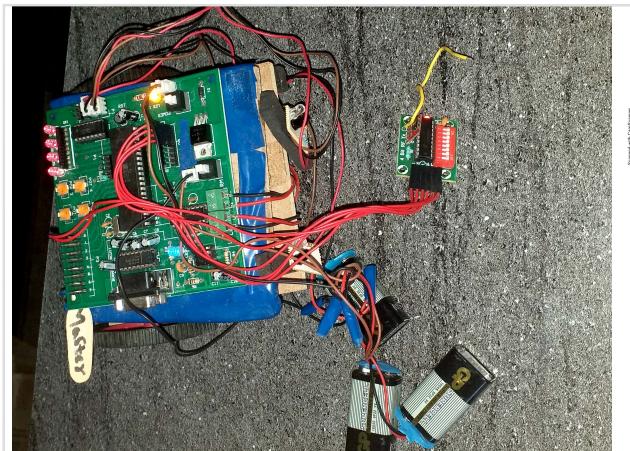
9) Comparator IC LM324 - The LM324 operational amplifier IC can be worked as a comparator. This IC has 4 independent operational amplifiers on a single chip. This a Low Power Quad Operational Amplifier and it has high stability, bandwidth which was designed to operate from a single power supply over a wide range of voltages. The input comes from IR sensors to this comparator.

10) Motor driver L293d - Motor Driver circuits are current amplifiers. They act as a bridge between the controller and the motor in a motor drive. Motor drivers are made from discrete components which are integrated inside an IC. The input to the motor driver IC or motor driver circuit is a low current signal. The function of the circuit is to convert the low current signal to a high current signal. This high current signal is then given to the motor. The motor can be a brushless DC motor, brushed DC motor, stepper motor, other DC motors etc. The output of this is sent to Dc motors

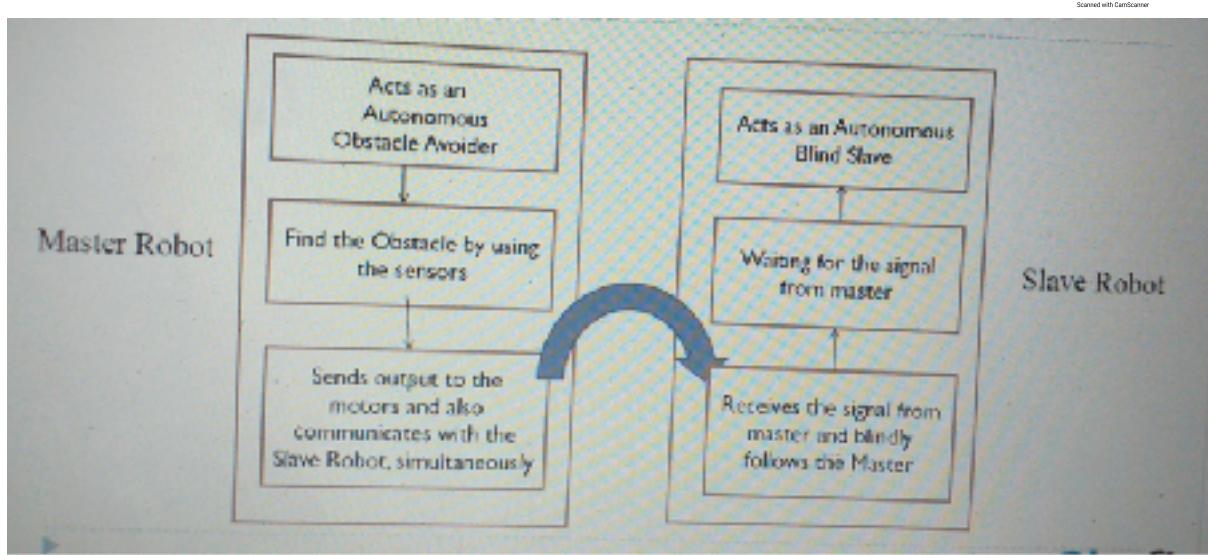
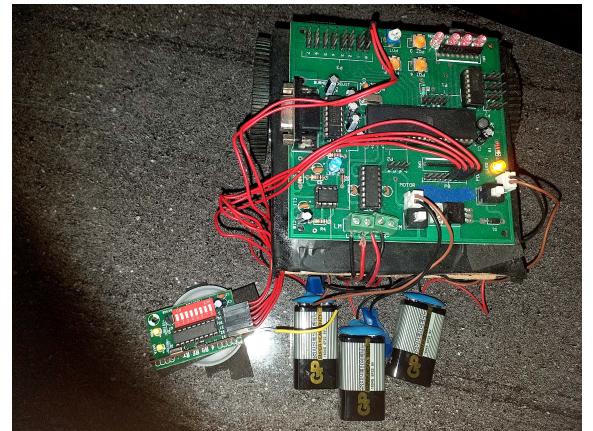
11) Antenna(transmitter and receiver's end)- As Antenna resides between cable/waveguide and the medium air, the main function of antenna is to match impedance of the medium with the cable/waveguide impedance. Hence antenna is impedance transforming device. The second and most important function of antenna is to radiate the energy in the desired direction and suppress in the unwanted direction. This basically is the radiation pattern of the antenna. This radiation pattern is different for different types of antennas.

3.2 Hardware Design

Master

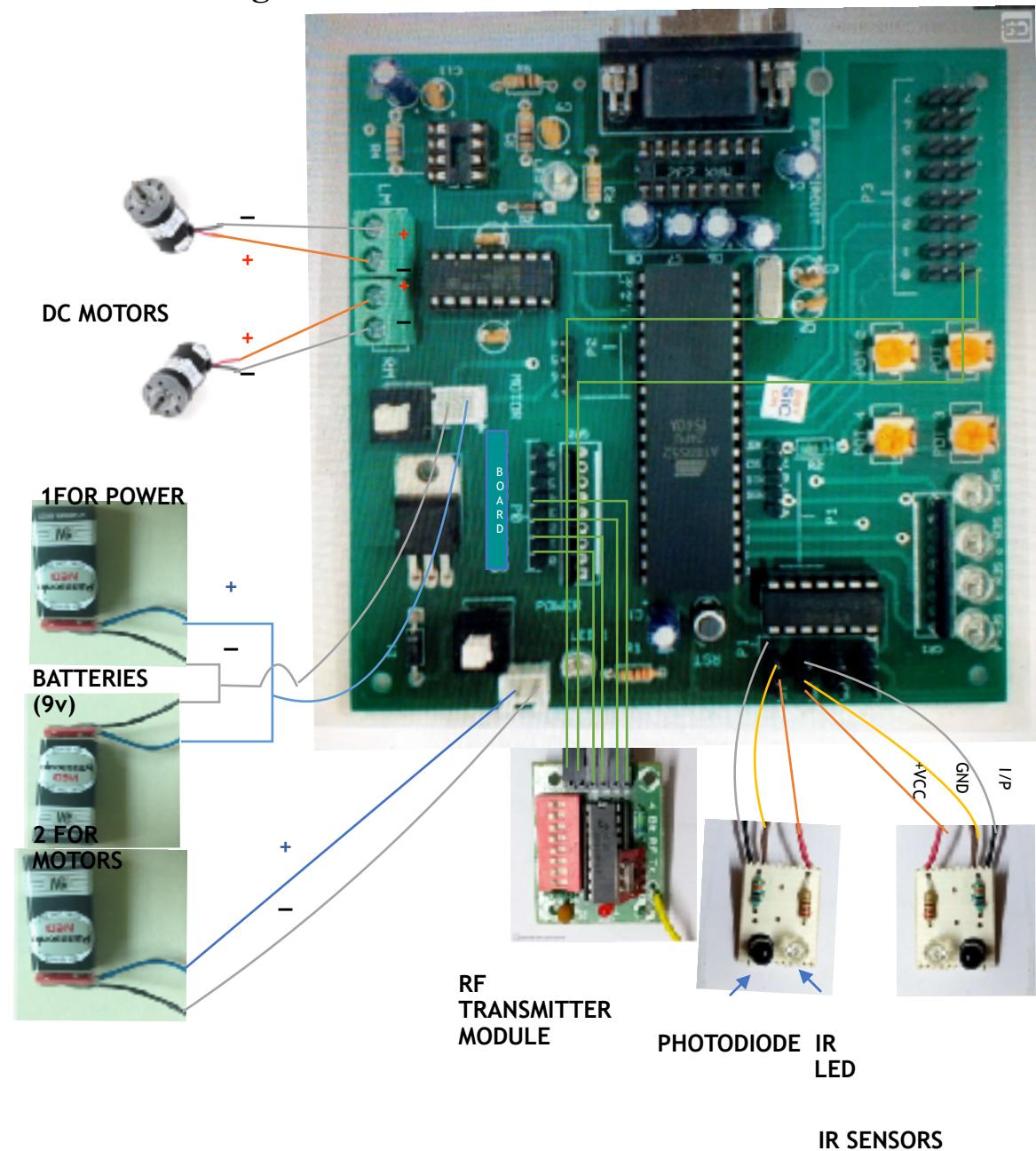


Slave

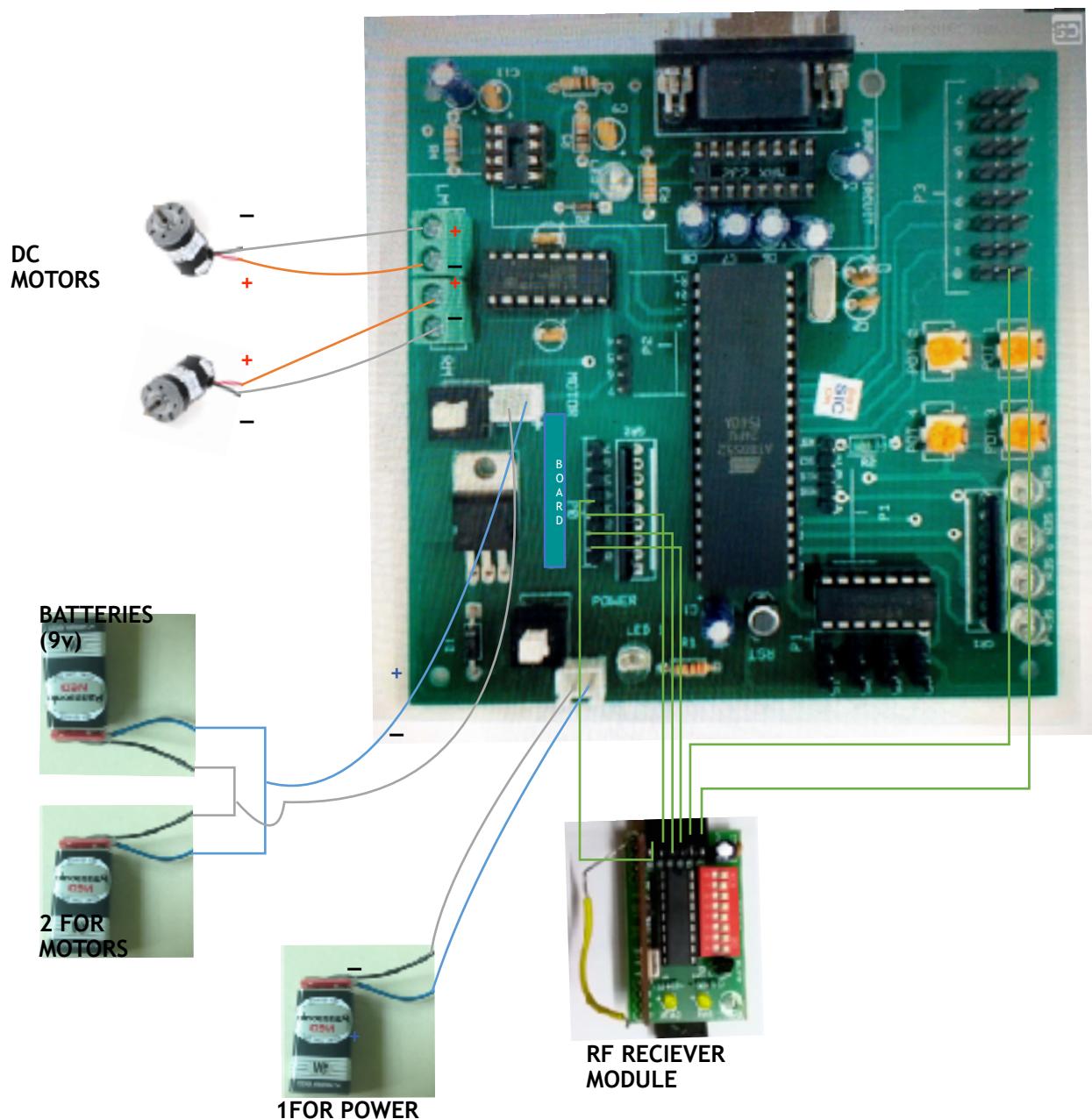


CHAPTER FOUR

4.0 Circuit Diagram



OBSTACLE AVOIDER MASTER BOT



BLIND SLAVE BOT

4.1 Component Description

Voltage Regulator-Pin Configuration

1

Input (V+)

Unregulated Input Voltage

2

Ground (Gnd)

Connected to Ground

3

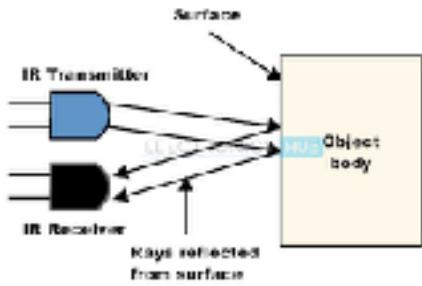
Output (Vo)

Outputs Regulated +5V

7805 Regulator Features

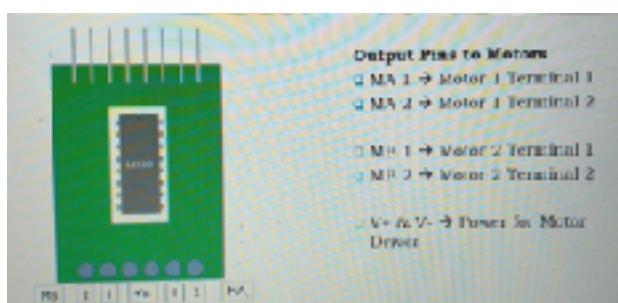
- 5V Positive Voltage Regulator
- Minimum Input Voltage is 7V
- Maximum Input Voltage is 25V
- Operating current(IQ) is 5mA
- Internal Thermal Overload and Short circuit current limiting protection is available.
- Junction Temperature maximum 125 degree Celsius
- Available in TO-220 and KTE package

IR Sensor-The principle of an IR sensor working as an Object Detection Sensor can be explained using the following figure. An IR sensor consists of an IR LED and an IR Photodiode; together they are called as Photo – Coupler or Opto – Coupler.



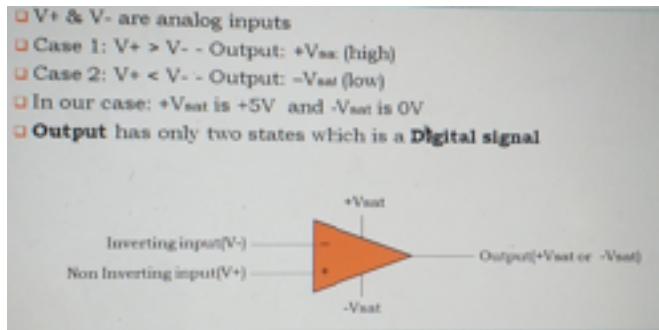
When the IR transmitter emits radiation, it reaches the object and some of the radiation reflects back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor is defined.

Motor DriverL293D- The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoids, DC and stepping motors) and switching power transistors. To simplify use as two bridges each pair of channels is equipped with an enable input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included. This device is suitable for use in switching applications at frequencies up to 5 kHz.. The L293DD is assembled in a 20 lead surface mount which has 8 centre pins connected together and used for heat sinking.



Comparator IC LM324 - The LM324 operational amplifier IC can be worked as a comparator. This IC has 4 independent operational amplifiers on a single chip. This a Low Power Quad Operational Amplifier and it has high stability, bandwidth which was designed

to operate from a single power supply over a wide range of voltages. The input comes from IR sensors to this comparator.



Microcontroller- The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 instruction set and pinout.

4 Bit RF Tx and 4 Bit RF Rx-This includes RF transmitter module,HT12E Encoder and Antenna.This radio frequency (RF) transmission system employs Amplitude Shift Keying (ASK) with transmitter/receiver (Tx/Rx) pair operating at 434 MHz. The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission.



4.2 Circuit Working

In the obstacle avoiding master bot, the IR sensors sense the obstacle using a photodiode and IR led across which there are resistors. When an obstacle is present at the front of the bot, The IR led constantly sends the Infrared signals which then are reflected back to the photodiode when the circuit is complete and voltage drops to 3.3volts. When there is no obstacle present in the front of the bot, the circuit is open. These 3 pins(input, ground and +vcc) connect to Port1 0,1,2,3 pins of the microcontroller which LM324 comparator converts analog input to digital output. Potentiometers are connected with LM324 for setting the reference voltage. The reference voltage gets calibrated based on obstacle distance. When the output voltage from sensor is less than reference voltage, it concludes the presence of obstacle. The IC 7805 acts like a voltage regulator thereby cutting down the voltage from 9volts to 5 volts. The 3 pins of IC 7805 are input at terminal 1, ground at terminal 2 and output at terminal 3. The regulated supply is for the circuitry. However, the motors need 2 batteries of 9 volts each and 1 battery is needed to power up the board. The left motor's positive and negative terminal is connected to negative terminal and positive terminal of the motor respectively. The right motor's positive and negative terminal is connected to the positive and negative terminal of the motor respectively. DC geared motors are used in this project. The motor with shaft are attached to a gear setup. Motor is chosen based on the RPM of the shaft. The positive polarity moves in a clockwise direction and negative in a counter-clockwise manner. An interface between micro controller and motors is the motor driver to supply enough current or voltage to motors. The port 0's 0,1,2 and 3 pins of the AT89S52 are connected to the B0,B1,B2,B3 for transmission of address and data to the 4bit RF transmitter module. The module consists of antenna, encoder-HT12E and RF transmitter. The RF is an alternating current which, if supplied to the antenna, will give rise to an electromagnetic field that propagates through space. RF range varies from 3kHz to 300GHz. The RF wave is received via a 4 bit RF Rx module which consists HT12D-decoder, antenna and RF receiver. Thereby, when the obstacle is detected the master reverses and changes it's direction causing the slave to mimic the same.

CHAPTER FIVE

5.0 Software Design



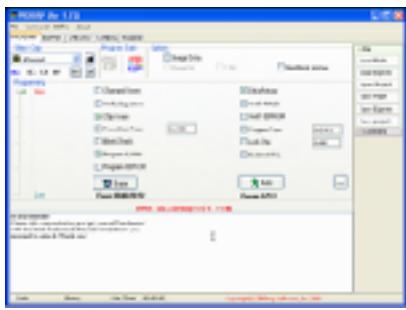
Keil was founded in 1982 by Günter and Reinhard Keil, initially as a German GbR. In April 1985 the company was converted to Keil Elektronik GmbH to market add-on products for the development tools provided by many of the silicon vendors. Keil implemented the first C compiler designed from the ground-up specifically for the 8051 microcontroller. Keil provides a broad range of development tools like ANSI C compiler, macro assemblers, debuggers and simulators, linkers, IDE, library managers, real-time operating systems.



USBasp is a USB in-circuit programmer for Atmel AVR controllers. It simply consists of an ATMega88 or an ATMega8 and a couple of passive components. The programmer uses a firmware-only USB driver, no special USB controller is needed.

Features

- Works under multiple platforms. Linux, Mac OS X and Windows are tested.
- No special controllers or smd components are needed.
- Programming speed is up to 5kBytes/sec.
- SCK option to support targets with low clock speed (< 1,5MHz).
- Planned: serial interface to target (e.g. for debugging)

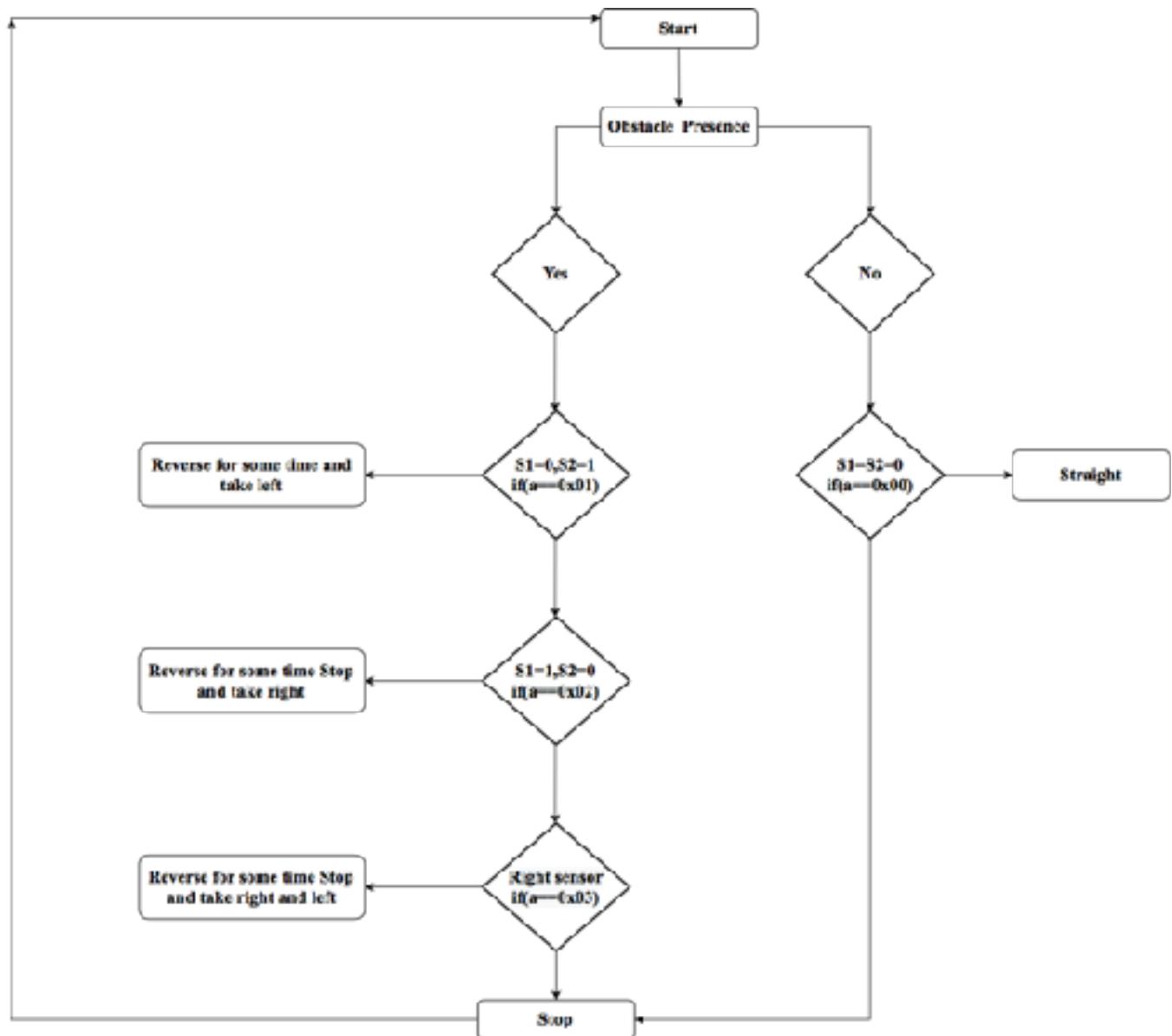


Progisp is a Chinese software which usually comes with the USBASP like the one showed before, it supports almost any AVR microcontroller and has a good user interface, it allows you to write and READ the ROM memory, fuse bits, and EEPROM, it informs you about errors, etc.

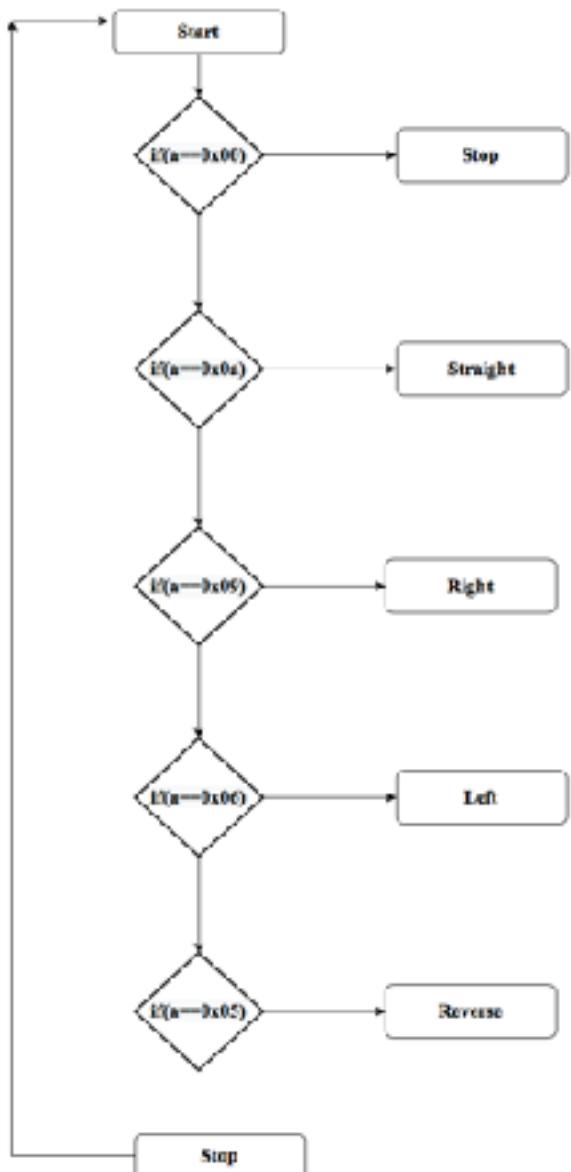
All Atmega microcontrollers can be programmed via ISP interface which consists of 6 lines tMOSI,MISO,SCK,RESET,VCC,GND. Connect this lines from your microcontroller to your programmer.

5.1 Flow Chart

Master



Slave



5.2 Algorithm

Master

- Start
- If $a==0x03$ meaning when obstacle is present at the front of both sensors($S1=1, S2=1$), the robot should reverse for a while, stop then turn either left or right. The master vehicle will continue to follow the command and direction unless another input is detected by the sensors.
- If $a==0x01$ meaning when obstacle is present in the front of the right sensor($S1=0, S2=1$), the robot should reverse for a while, stop and then turn left. The master will continue to follow the command and direction unless another input is detected by the sensors.
- If $a==0x02$ meaning when obstacle is present in the front of the left sensor($S1=1, S2=0$), the robot should reverse for a while, stop and then turn right. The master will continue to follow the command and direction unless another input is detected by the sensors.
- If $a==0x00$ meaning when no obstacle is present in the front of both the sensors($S1=0, S2=0$), the robot should continue moving straight. The master will continue to follow the command and direction unless another input is detected by the sensors.

Slave

- Start
- If $a==0x0a$ meaning this motor input causes straight movement of the bot. The slave vehicle will continue to follow the command and direction unless another input is changed by the motor rotation.
- If $a==0x06$ meaning this motor input causes left movement of the bot. The slave vehicle will continue to follow the command and direction unless another input is changed by the motor rotation.

- If a==0x00 meaning this motor input causes stop the bot to stop.The slave vehicle will continue to follow the command and direction unless another input is changed by the motor rotation.
- If a==0x09 meaning this motor input causes right movement of the bot.The slave vehicle will continue to follow the command and direction unless another input is changed by the motor rotation.
- If a==0x05 meaning this motor input causes reverse movement of the bot.The slave vehicle will continue to follow the command and direction unless another input is changed by the motor rotation.

5.3 Program

Master

The screenshot shows the Microsoft Visual Studio IDE interface. The title bar reads "D:\Kek\HSE\hw03\ - position". The menu bar includes File, Edit, View, Build, Tools, Debug, Project, Tools, FxCop, Windows, Help. The toolbar has icons for New, Open, Save, Print, Cut, Copy, Paste, Find, Replace, and others. The Solution Explorer on the left shows a project named "hw03" with a target "Target 1" containing a source group "Source Group 1" with files "STARTUP.A" and "MAIN.C". The main code editor window displays the following C code:

```
1 // Declaring Header file
2 #include<stdio.h>
3 #include<conio.h>
4
5 #define COUNT 1000000
6 #define N 1000000
7 #define M 1000000
8 #define K 1000000
9 #define L 1000000
10
11 unsigned int A;
12 void B();
13
14 while(1)
15 {
16     int m=0;
17     if(m==0)
18     {
19         int n=0;
20         if(n==0)
21         {
22             int o=0;
23             if(o==0)
24             {
25                 int p=0;
26                 if(p==0)
27                 {
28                     int q=0;
29                     if(q==0)
30                     {
31                         int r=0;
32                         if(r==0)
33                         {
34                             int s=0;
35                             if(s==0)
36                             {
37                                 int t=0;
38                                 if(t==0)
39                                 {
40                                     int u=0;
41                                     if(u==0)
42                                     {
43                                         int v=0;
44                                         if(v==0)
45                                         {
46                                             int w=0;
47                                             if(w==0)
48                                             {
49                                                 int x=0;
50                                                 if(x==0)
51                                                 {
52                                                     int y=0;
53                                                     if(y==0)
54                                                     {
55                                                         int z=0;
56                                                         if(z==0)
57                                                         {
58                                                             B();
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Slave

```
1 // Declares Header File
2 #INCLUDE<regid.h>
3 #INCLUDE<Windows.h>
4
5 #INCLUDE<stdio.h>
6 #include <iomanip>;
7 #include <iostream>;
8 #include <iomanip>;
9 #include <iomanip>;
10
11 cin>>n>>m;
12 void main();
13 {
14     while(1)
15     {
16         cout<<n<<endl;
17         if(n==0)
18             break;
19         cout<<m<<endl;
20         if(m==0)
21             break;
22         cout<<n+m<<endl;
23         if((n+m)==0)
24             break;
25     }
26 }
```

```
9 #include<iomanip>;
10
11 cin>>n>>m;
12 void main();
13 {
14     while(1)
15     {
16         cout<<n<<endl;
17         if(n==0)
18             break;
19         cout<<m<<endl;
20         if(m==0)
21             break;
22         cout<<n+m<<endl;
23         if((n+m)==0)
24             break;
25     }
26 }
```

CHAPTER SIX

6.0 Component List with Cost

SNO	COMPONENTS	QUANTITY	COST
1	Battery (9v)	6	500
2	BOI Motors Straight Type	4	1200
3	Castor wheels	1	300
4	2 pin connectors	6	250
5	IR Sensors	2	300
6	USBASP Program Cable	1	250
7	IC 7805	1	75
8	4 Bit RFTx	1	150
9	4 Bit RFRx	1	150
10	Development Board	2	2000
11	Microcontrolle r	2	
12	OP-Amp LM324	2	
13	Motor Driver L293d	2	
14	4 LEDS		
15	4 Pots		
16	Male pin connectors		
17	Female pin connectors		

CHAPTER SEVEN

Despite its potential to promote robustness, scalability and flexibility, swarm robotics has yet to be adopted for solving real-world problems. Various limiting factors are preventing the real-world uptake of swarm robotics systems. It is non-optimal because they are redundant and have no central control, lack of central control sometimes swarms behave independently. So swarm systems are inefficient. Swarms communicate with each other through messages but sometimes indirect communications are required like communicating through gesture, posture but swarms cannot communicate indirectly. Social insects like ants are able to find the shortest path by sensing the global environment but swarm robotics cannot sense global knowledge from environment so they cannot behave dynamically and it leads to deadlock of the whole system, so recovery is required to move from the stagnation. Complex swarm systems with rich hierarchies take time to boot up. Greater the complexities, the longer it takes to warm up. So it is non-immediate to so many tasks where active attention is needed. The swarm robotics behave strangely in unpredictable environment so desired task cannot be performed. Swarm robotics is homogenous systems. All robots behave in a similar manner. If it is required to work in an environment where heterogeneity is needed then we cannot use swarm. Because of internet limitations sometimes swarms might not be able to communicate so creation of their own network required for uninterrupted work, and it might be costly affair. As compared to single robot, swarms are cheaper but maintenance is high. Weather affects swarm robots severely, as weather changes create communication problem among robots. So coordination between robots is affected. Human cannot take part in group of robots as sometimes natural intelligence is required to accomplish the task. For each and every behavioral change we need to reprogram and it may affect the previous coding of the robot .So whole swarm are required to be recoded again. But it cannot bring the natural intelligence inside the swarm. A systematic and general way to design robot swarms is still missing, even though a few preliminary proposals have been made. Securities issues are vital as Physical capturing of the robots are possible. There must be a provision to Identify and authenticate robot because a robot must know if it is interacting with a robot from its swarm or from an intruder robot. Communications can be intercepted or disturbed by an attacker. The major threats to military systems are from deliberate attacks on the robotic swarm. Such attacks may range from passive eavesdropping on communications , or monitoring traffic to more sophisticated attacks where malicious robots may be injected into the swarm , much as viruses and Trojans in computer systems. Such sophisticated attacks may go unnoticed while the attacker manipulates data being processed by the swarm and possibly affects the emergent behavior. Swarm robotics has the characteristic of fault tolerance. If few of the robots stop working even then swarm will work but performance slowdown can be seen. There is a system where a fix distance between robots should be maintained because they work on the rule of long range attraction and short range repulsion. If a number of robots become less then they would not be able to communicate and coordinate with each other according to above rule. So it challenges the fault tolerant feature.

7.1 Advantages

The whole task can be divided into subtasks, assigned to individual member of the swarm so that they can work in parallel to enhance the performance. Swarm robots work in a wider range area to accomplish a single goal task which is not possible in single robot system. If the single robot stops working in a group the task will not be halted, it will be done by the other members of the group. It means it is fault tolerant. It implements the distributed action, where a group of robots can actuate in different places at the same time. Parallelism means to accomplish a task concurrently. By using this technique task can be done more quickly than by a single robot. Robustness means no single point of failure for the system. If one system fails, the work doesn't get stopped. Scalability means better performance as compared to centralized system, if it will have to cover wide area. Heterogeneousness means each members of the group is heterogeneous or different whose physical properties enable them to perform efficiently. Flexibility means easily reconfigured for the different applications. It has the ability to adopt different behavior as per the need. Complex problems can be solved easily using a swarm of robots which might be impossible for a single robot. Cheap Alternative means each group member of swarm is simple robot which is cheaper than single powerful robot for each separate task. Stable, if one member fails in a group, the work won't get stopped but their performance may degrade. It is useful for the task where the environment is dangerous. Economical benefits, swarm robotics cost low in designing, manufacturing as compared to single robot. Energy efficient means that the life time of the swarm is large. In an environment which has no fueling facilities or where wired electricity is forbidden, the swarm robotics can be much useful than traditional single robot.

Agricultural area, by using this technique we can easily sow the seed, harvest, and store the grains in the warehouse, thus the work load of farmers gets decreased and they will be able give their time to think how the production can be increased. In Military applications, it is very much useful in detecting bomb which is most dangerous task for the humans and in these applications the need for security is perhaps self-evident. There is currently a great deal of a research taking place in the military use of robotics swarms. It is useful in traffic pattern in transportation system. In medical fields, a use of nano-robots moving through human veins and arteries (e.g. to fight certain types of cancer). It is useful in Post disaster relief where humans can't reach we can easily introduce swarm robots individuals so we can use it where help is needed to search the target. We can also use it for deployment of distributed agents and for area coverage. To control mob swarm robots are the best choice as compared to humans. The swarm could response as quickly as possible to the emergency at hand. Robots may be used to perform tasks that are too dangerous or difficult for humans to implement directly (e.g. nuclear waste cleanup) or may be used to automate repetitive tasks that can be performed more cheaply by a robot than by the employment of a human (e.g. automobile production, shopping malls, hotels, etc) or may be used to automate mindless repetitive tasks that should be performed with more precision by a robot than by a human(material handling, material transfer applications, machine loading and unloading, processing operations, assembly and inspection). There are many industries which use dangerous things like burning furnace, chemicals, making nuclear weapons etc. Here usage of swarms can reduce danger in such types of industries. As police agents also Swarm robots are beneficial. If we use it in survey purpose, the time and money both can be saved. Some of the hospital functions that might be automated include delivering linens, making beds, clerical duties such as entering patient records into computer file, delivering medicines and supplies from the hospital pharmacy and central supply and transporting patients for different services in the building. To handle events like social events, conducting conferences etc. swarms are useful. It can be applied for mining application. Sometimes mining work could be hazardous to human life so swarm robotics can be helpful. It also includes Collective exploration, shortest path finding and efficient task allocation, transport sub-task, which covers the important issue of collective transport. In hilly areas building roads is challenging for human but through swarm robotics road construction is easy and in the same way it is used in other engineering task also.

7.2 Limitations

CHAPTER EIGHT

8.0 Applications

- military
- Submarine

Radiation explosion plant the robot can send,

Graphical Creation,

wireless control in anywhere the robot is connected

8.1 Future Scope

- The Swarm robots can be made more script friendly for the sci-fi action movies to revolve around the same.
- The bots can be used in form of characters for the theme parks and stories.
- They can aid in interactive education for the young ones.
- They can be used for prediction of threats using data science

CHAPTER NINE

9.0 Result

Case	Left Sensor S1	Right Sensor S2	Input condition in Hex at Port P1	Robot Movement
1	1	1	0x03	Reverse for some time -Stop-and Take left or right
2	0	1	0x01	Reverse for some time-Stop-and Take left
3	1	0	0x02	Reverse for some time -Stop-and Take right
4	Bot Movement		Motor Rotation	

Sensor Input	Bot Movement	Wheel Movement	
		Left Wheel	Right Wheel
0000(0x00)	Stop	Stop	Stop
0001(0x01)	Right	Forward(F)	Reverse(R)
0010(0x02)	Left	Reverse(R)	Forward(F)
0011(0x03)	Forward	Forward(F)	Forward(F)

9.1 Conclusion

As swarm robotics have lot of features but still it is not widely acceptable to solve the real life problems. Further research is needed on robotic hardware to overcome hardware shortcomings that limit the functionality of current robotic systems. Central control limits the functionality of swarm robotics but there can be a robot among swarm which has the capability of sensing and repairing hardware defect of other robots and also has leadership quality to control and guide distributed autonomous robots in desirable situation. Further research on behavioral control is needed to discover effective ways to let a human operator interact with a robot swarm. Indirect communication might get enhanced in future. In the remote location and for the outhouse applications, to charge battery solar energy might become feasible in near future.

CHAPTER TEN

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