SOLAR BASED ROBOT USING BLUETOOTH

A project Report

Submitted in partial fulfillment of the requirements

For the award of degree of

BACHELOR OF TECHNOLOGY

In

ELECTRONICS &COMMUNICATION ENGINEERING

Under the Guidance of

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CERTIFICATE

This is to certify that the project report entitled **"SOLAR BASED ROBOTUSING BLUETOOTH"** is submitted by **J.LAKSHMI** bearing H.T.NO:15HT1A0440, M.BALA SIREESHA bearing H.T.NO:15HT1A0456, **D.H.S.N.KOTESWARI** bearing **H.T.NO:15HT1A0421, G.SUNITHA** bearing **H.T.NO:15HT1A0435, B.NARSIREDDY** bearing **H.T.NO:15HT1A0406, K.V.NARSAIAH** bearing **H.T.NO:15HT1A0444** in partial fulfillment of the requirements for the award of the degree of **BACHELOR OF TECHNOLOGY IN ELECTRONICS AND COMMUNICATION ENGINEERING**to the Jawaharlal Nehru Technology University, Kakinada is a record of bonafide work carried out by them under my guidance and supervision.

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ACKNOWLEDGEMENT

We take the opportunity to thank one and all who have helped in marketing the project successful.

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DECLARATION

We are the students of **CHALAPATHI INSTITUTE OF TECHNOLOGY** A.R. Nagar , MOTHADAKA, hereby declare that the project entitled **"SOLAR BASED ROBOT USING BLUETOOTH"** title submitted to Jawaharlal Nehru Technological University, Kakinada for the award of degree of **BACHELOR OF TECHNOLOGY,** is the bonafide project work done by us.

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ABSTRACT

A robot is a mechanical or virtual artificial agent. In practice, it is usually an electro mechanical system which, by its appearance or movements, conveys a sense that it has intent or agency of its own .The word robot can refer to both physical robot and virtual software agents, as robots, but there is general agreement among experts and robots tend to do some or all of the following: move around, operate a mechanical arm, sense and manipulate their environment, and exhibit intelligent behavior, especially behaviour which mimics humans or animals**.**

This projects is built on AT89S52 microcontroller, with the power from a solar panel .That is the power required for the robot to move will be derived from a solar panel connected to the battery of the system .This project also displays the status of charging and not charging by using a controller circuit which makes the use of solar power when the panel is in a bright light, else the power will be taken from a battery. L293D IC is used to drive the motors of the robot.

This Bluetooth module enables you to wireless transmit &receive serial data. A drop in replacement for wired serial connections allowing transparent two way data communication.

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LIST OF ABBREVATIONS

RAM	-	Random Access Memory
ROM	-	Read Only Memory
CPU	-	Central Processing Unit
PC	-	Program Counter
MCU	-	Micro Controller Unit
CMOS	-	Complementary Metal Oxide Semiconductor
PEROM	-	Programmable & Erasable Read Only Memory
UART	-	Universal Asynchronous Receiver &Transmitter
ALE	-	Address Latch Enable
PSEN	-	Program Store Enable
EA	-	External Access
PSW	-	Program Status Word
AC	-	Auxiliary Carry
DPTR	-	Data Pointer
SFRS	-	Special Function Registers
LSB	-	Least Significant Bit
NREL	-	National Renewable Energy Laboratory
AFH	-	Adaptive Frequency Hopping
EDR	-	Enhanced Data Rate

CHAPTER 1

EMBEDDED SYSTEMS

1.1. INTRODUCTION TO EMBEDDED SYSTEMS

An embedded system is a special-purpose computer system designed to perform one or a few dedicated functions, sometimes with real-time computing constraints. It is usually embedded as part of a complete device including hardware and mechanical parts. In contrast, a general-purpose computer, such as a personal computer, can do many different tasks depending on programming. Embedded systems have become very important today as they control many of the common devices we use.

Since the embedded system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product, or increasing the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Physically embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

In general, "embedded system" is not an exactly defined term, as many systems have some element of programmability. For example, Handheld computers share some elements with embedded systems — such as the operating systems and microprocessors which power them — but are not truly embedded systems, because they allow different applications to be load and peripherals to be connected.

An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a particular kind of application device. Industrial machines, automobiles, medical equipment, cameras, household appliances, airplanes, vending machines, and toys (as well as the more obvious cellular phone and PDA) are among the myriad possible hosts of an embedded system. Embedded systems that are programmable are provided with a programming interface, and embedded systems programming is a specialized occupation. The program is written permanently into the system's memory in this case, rather than being loaded into RAM (random access memory), as programs on a personal computer are.

1.2. CHARACTERISTIC OF EMBEDDED SYSTEM

- Speed (bytes/sec): Should be high speed
- Power (watts): Low power dissipation
- Size and weight: As far as possible small in size and low weight
- Accuracy (%error): Must be very accurate
- Adaptability: High adaptability and accessibility
- Reliability: Must be reliable over a long period of time

1.3. APPLICATIONS OF EMBEDDED SYSTEMS

We are living in the Embedded World. You are surrounded with many embedded products and your daily life largely depends on the proper functioning of these gadgets. Television, Radio, CD player of your living room, Washing Machine or Microwave Oven in your kitchen, Card readers, Access Controllers, Palm devices of your work space enable you to do many of your tasks very effectively. Apart from all these, many controllers embedded in your car take care of car operations between the bumpers and most of the times you tend to ignore all these controllers.

- **Robotics:** industrial robots, machine tools, Robocop soccer robots
- **Automotive:** cars, trucks, trains
- **Aviation:** airplanes, helicopters
- Home and Building Automation
- **Aerospace:** rockets, satellites
- **Energy systems:** windmills, nuclear plants
- **Medical systems:** prostheses, revalidation machine.

1.4. MICROCONTROLLER VERSUS MICROPROCESSOR

What is the difference between a Microprocessor and Microcontroller? By microprocessor is meant the general purpose Microprocessors such as Intel's X86 family (8086, 80286, 80386, 80486, and the Pentium) or Motorola's 680X0 family (68000, 68010, 68020, 68030, 68040, etc). These microprocessors contain no RAM, no ROM, and no I/O ports on the chip itself. For this reason, they are commonly referred to as general-purpose Microprocessors.

A system designer using a general-purpose microprocessor such as the Pentium or the 68040 must add RAM, ROM, I/O ports, and timers externally to make them functional. Although the addition of external RAM, ROM, and I/O ports makes these systems bulkier and much more expensive, they have the advantage of versatility such that the designer can decide on the amount of RAM, ROM and I/O ports needed to fit the task at hand. This is not the case with Microcontrollers.

A Microcontroller has a CPU (a microprocessor) in addition to a fixed amount of RAM, ROM, I/O ports, and a timer all on a single chip. In other words, the processor, the RAM, ROM, I/O ports and the timer are all embedded together on one chip; therefore, the designer cannot add any external memory, I/O ports, or timer to it. The fixed amount of on-chip ROM, RAM, and number of I/O ports in Microcontrollers makes them ideal for many applications in which cost and space are critical.

In many applications, for example a TV remote control, there is no need for the computing power of a 486 or even an 8086 microprocessor. These applications most often require some I/O operations to read signals and turn on and off certain bits

1.5. MICROCONTROLLERS FOR EMBEDDED SYSTEMS

In the Literature discussing microprocessors, we often see the term Embedded System. Microprocessors and Microcontrollers are widely used in embedded system products. An embedded system product uses a microprocessor (or Microcontroller) to do one task only. A printer is an example of embedded system since the processor inside it performs one task only; namely getting the data and printing it. Contrast this with a Pentium based PC. A PC can be used for any number of applications such as word processor, print-server, bank teller terminal, Video game, network server, or Internet terminal. Software for a variety of applications can be loaded and run. Of course the reason a pc can perform myriad tasks is that it has RAM memory and an operating system that loads the application software into RAM memory and lets the CPU run it.

. In this robot as the fire sensor senses the fire, it senses the signal to microcontroller. In an Embedded system, there is only one application software that is typically burned into ROM. An x86 PC contains or is connected to various embedded products such as keyboard, printer, modem, disk controller, sound card, CD-ROM drives, mouse, and so on. Each one of these peripherals has a Microcontroller inside it that performs only one task.

1.6. ROBOTICS

Robot is defined as a mechanical design that is capable of performing human tasks and behaving like human in nature. These technologies are used to develop machines that can substitute for humans and replicate human actions. Robots can be used in many situations and for lots of purposes, but today many are used in dangerous environments (including bomb detection and deactivation), manufacturing processes, or where humans cannot survive (e.g. in space). Robots can take on any form but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviors usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, and basically anything a human can do. Many of today's robots are inspired by nature.

CHAPTER 2
INTRODUCTION TO PROJECT

2.1. WORKING

A robot is a mechanical or virtual artificial agent. In practice, it is usually an electro-mechanical system which, by its appearance or movements, conveys a sense that it has intent or agency of its own. The word robot can refer to both physical robots and virtual software agents, but the latter are usually referred to as Robots. There is no consensus on which machines qualify as robots, but there is general agreement among experts and the public that robots tend to do some or all of the following: move around, operate a mechanical arm, sense and manipulate their environment, and exhibit intelligent behavior, especially behavior which mimics humans or animals.

Bluetooth is a wireless module which transfers data. This module enables you to transmit & receive wireless data in serial format. It is an advanced technology which can is widely used now-a-days in mobile data sharing and within network communications like modem to printer, etc. Allowing transparent two way data communication. In our project we can simply use it for transmitting wireless serial data to establish connection between MCU or embedded project and mobile. The range of Bluetooth modem is 10 meters with frequency 2.4 GHz. Blue tooth Transmit power is 4dBm and sensitivity is 84 dBm. We have to control robot navigation using Bluetooth.

This project is built on 8051 micro controller, with the power from a solar panel. i.e. the power required for the robot to move will be derived from a solar panel a connected to the battery of the system. This project also displays the status of charging and not charging by using a controller circuit which makes the use of solar power when the panel is in a bright light, else the power will be taken from a battery. L293D IC is used to drive the motors of the robot.

This project uses regulated 5V, 500mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Full wave bridge rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

2.2BLOCK DIAGRAM

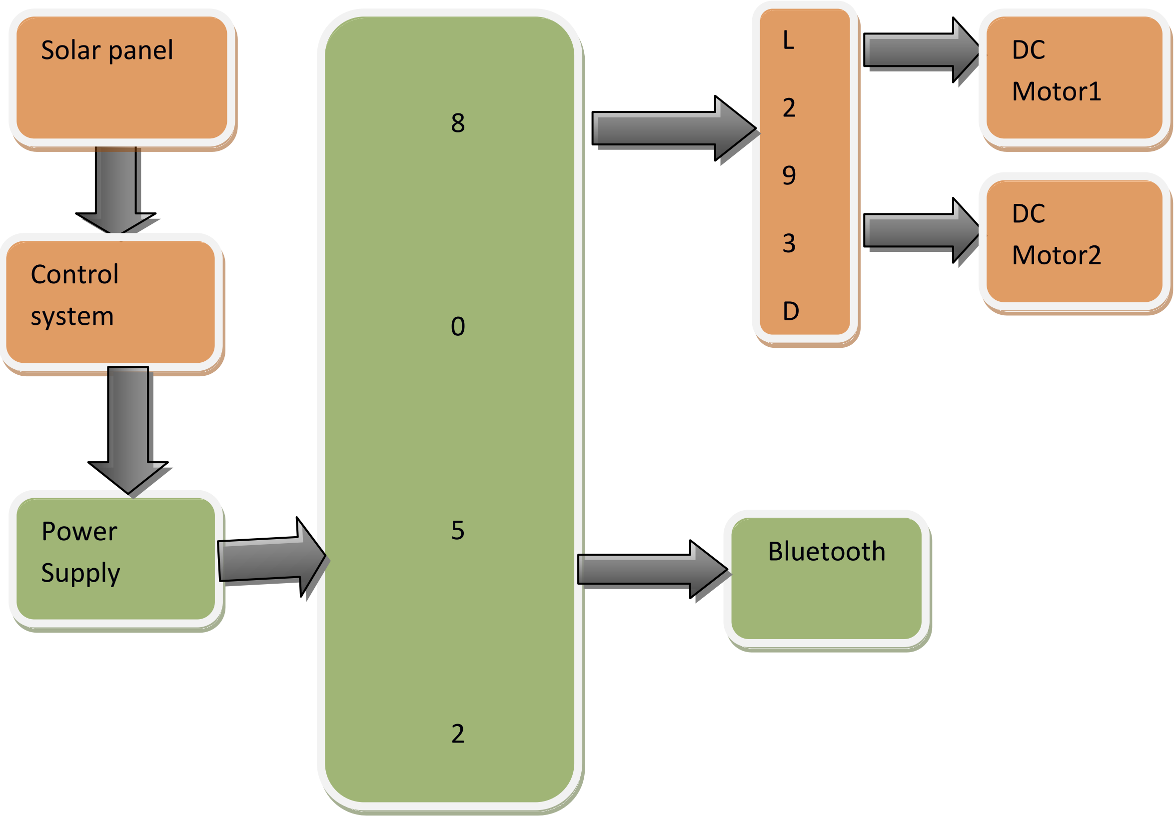

Fig.2.1. Block Diagram

2.3. ADVANTAGES

- Renewable energy - The energy can be used both to generate electricity and heat in the house. Renewable energy is recovered from the sun, the wind and waves - which in this case is the sun. Solar cells harness the energy from the sun and transform this into usable electricity..
- Environmentally friendly energy - With solar cells occurs almost no pollution. The discharge of waste and pollution is unavoidable in relation to the production of solar cells, the transport of these and when you install them.

2.4. APPLICATIONS

- Robotics
- Automatic control systems

CHAPTER 3

AT89S52 MICROCONTROLLER

The AT89S52 is a low-power, high-performance CMOS 8-bit microcomputer with 4 Kbytes of Flash Programmable and Erasable Read Only Memory (PEROM). The device is manufactured using Atmel‘s high-density non-volatile memory technology and is compatible with the industry standard MCS-51Ô instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcomputer, which provides a highly flexible and cost effective solution to many embedded control applications.

3.1. FEATURES OF MICROCONTROLLER

- Compatible with MCS-51TM Products.
- 8 Kbytes of In-System Reprogram able Flash
  Memory-Endurance: 1,00Write/Erase Cycles.
- Fully Static Operation: 0 Hz to 24 MHz
- Three-Level Program Memory Lock.
- 256 x 8-Bit Internal RAM.
- 32 Programmable I/O Lines.
- Three 16-Bit Timer/Counters.
- Eight Interrupt Sources.
- Programmable Serial Channel.
- Low Power Idle and Power Down Modes.
- 4.0v to 5.5v Operating Range.
- Full Duplex UART Serial Channel.
- Interrupt Recovery from Power-down Mode.
- Watchdog Timer.
- Dual Data Pointer.

- Power-off Flag.
- Fast programming time.

3.2. PIN CONFIGURATION

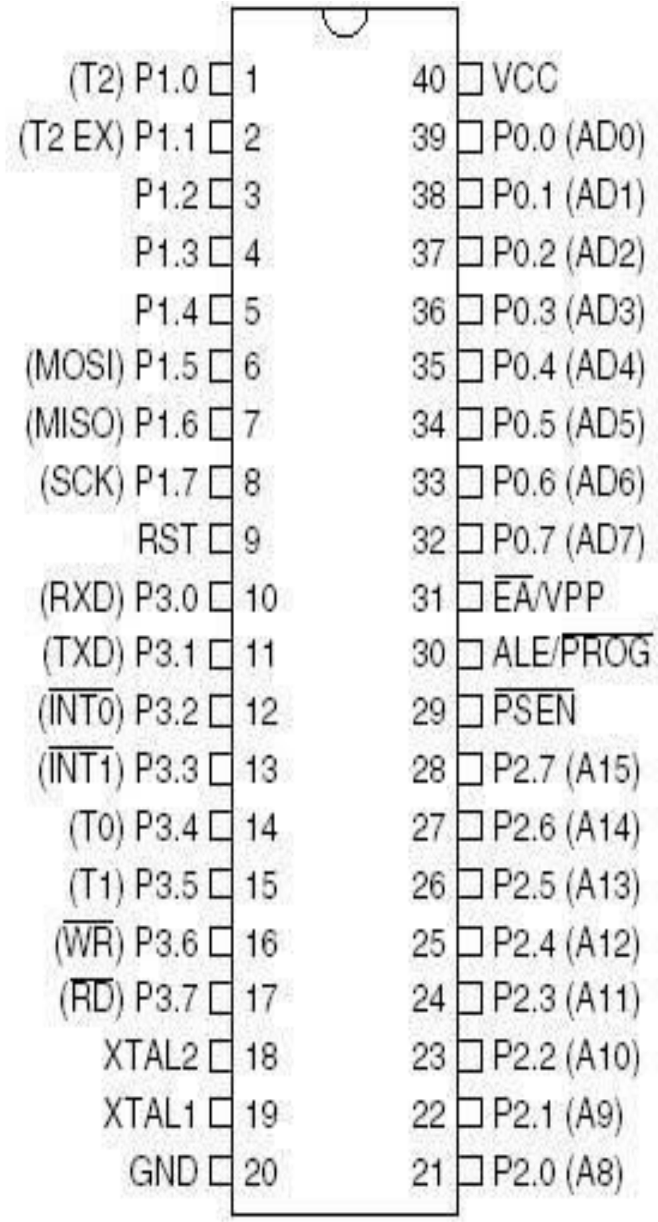

Figure.3.1. Pin configuration of AT89S52 Microcontroller

3.2.1. Pin description

VCC: Supply voltage

GND: Ground

Ports:

All ports are bi-directional; each consists of a latch, an output driver and an input buffer. P0, P1, P2 and P3 are the SFR latches ports 0, 1, 2 and 3 respectively. The main functions of each port are mentioned below.

Port0: input/output bus port, address output port and data input/output port.

Port1: Quasi-bi-directional input/output port.

Port2: Quasi-bi-directional input/output port and address output port.

Port3: Quasi-bi-directional input/output port and control input/output pin.

RST:

Reset pin. A high on this pin for two machine cycles while oscillator is running resets the device

ALE/PROG:

Address Latch Enable (ALE) is an output pulse for latching the lower byte of address during access to external memory. This pin is also the program pulse input (PROG) during flash programming.

PSEN:

Program Store Enable (PSEN) is the read strobe to external program memory. When the AT89S52 is executing the code from external program memory , PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

EA/VPP:

External Access Enable. EA must be strapped to ground in order to enable the device to fetch code from external program memory locations starting at 0000H to FFFFH. EA should be strapped to VCC for internal program executions.

XTAL 1:

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL 2: Output from an inverting oscillator amplifier.

3.3. ARCHITECTURE OF 8052:

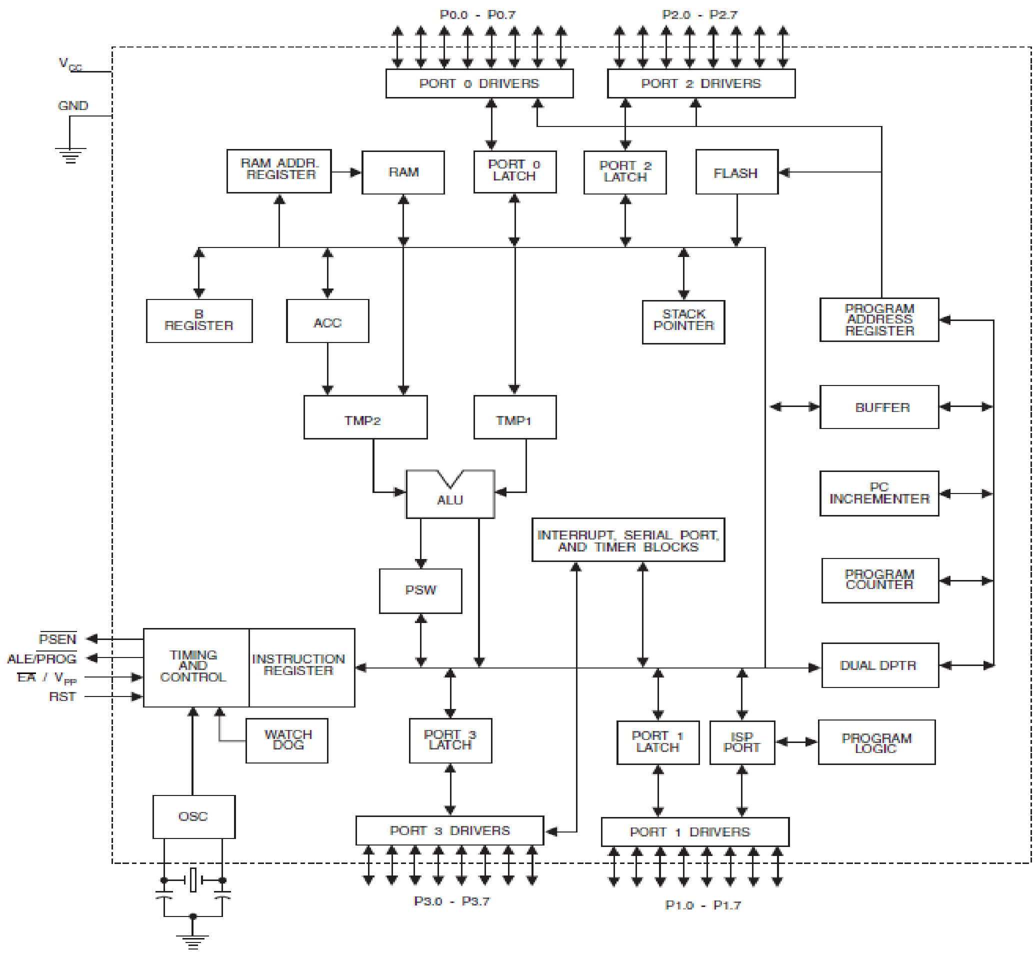

Figure.3.2. Architecture of 8052

Special function registers

3.3.1. A & B Registers

They are used during math and logically operations. The register A is also used for all data transfers between the micro controller and memory. The B register is used during multiplication and divided operations. For other instructions it can be treated as another scratch pad register.

3.3.2. PSW (program status word)

It contains math flags; user flags F0 and register select bits RS1 and RS0 to determine the working register bank.

3.3.3. Stack and Stack pointer

Stack is used to hold and retrieve data quickly. The 8 – bit SP is incremented before data is stored during PUSH and CALL executions. While the stack may reside anywhere in on-chip RAM, the SP is initialized to 07H after the stack to begin at manipulated as a 16 – bit register or as two independent 8 – bit register.

3.3.4. PC (program counter)

It addresses the memory locations that program instructions are to be fetched. It is the only register that does not have any internal address.

3.3.5. Flags

They are 1–bit register provided to store the results of certain program instructions. Other instructions can test the conditions of the flags and make the decisions accordingly. To conveniently address, they are grouped inside the PSW and PCON. The micro controller has 4 main flags: carry(c), auxiliary carry (AC), over flow (OV), parity (P) and 3 general-purpose flagsF0, GF0 and GF1.

3.3.6. SBUF (Serial Buffer)

The microcontroller has serial transmission circuit that uses SBUF register to hold data. It is actually two separate registers, a transmit buffer and a receive buffer register.

When data is moved to SBUF, it goes to transmit buffer, where it is held for serial transmission and when it is moved from SBUF, it comes from the receive buffer

3.4. TIMER REGISTERS

Register pairs (TH0, TL1), (TH1, TL1) are the 16-bit counter registers for timer/counters 0 and 1.

3.4.1. Control registers

SFR‘s, IP, TMOD, SCON and PCON control and status bits for the interrupt system, Timers/counters and the serial port.

3.4.2. Oscillator and clock circuit

This circuit generates the clock pulses by which all internal operations are synchronized. For the microcontroller to yield standard baud rates, the crystal frequency is chosen as 11.059MHz.

3.5. MEMORY ORGANISATION

The 89S52 micro controller has separate address for program memory and data memory. The logical separation of program and data memory allows the data memory to be accessed by 8-bit address, which can be quickly stored and manipulated by an 8-bit CPU.

Nevertheless, 16-bit data memory address can also be generated through the DPTR register. Program memory (ROM, EPROM) can only be read, not written to. There can be up to 64k bytes if program memory the lowest 4k bytes of program are on chip. In the ROM less versions, all program memory is external.

The read strobe for external program is the PSEN (program store enable). Data memory (RAM) occupies a separate address space from program memory the lowest 128 bytes of data memory are on chip. Up to 64 bytes of external RAM can be addressed in the external data memory space.

3.5.1. Data memory

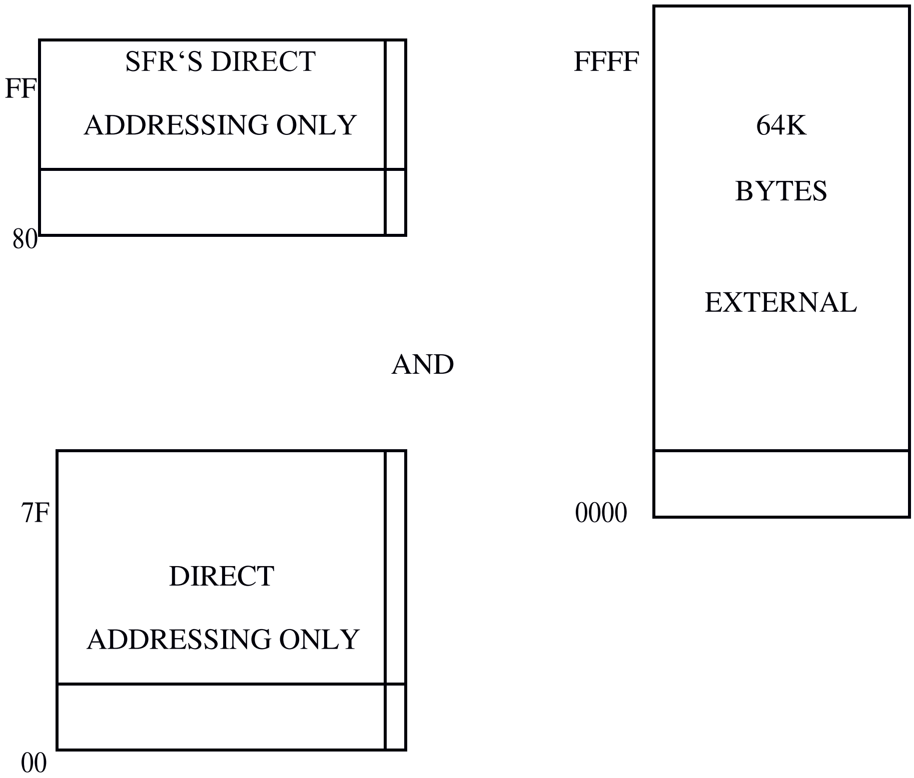

Figure.3.3. Data memory

3.5.2. Program memory

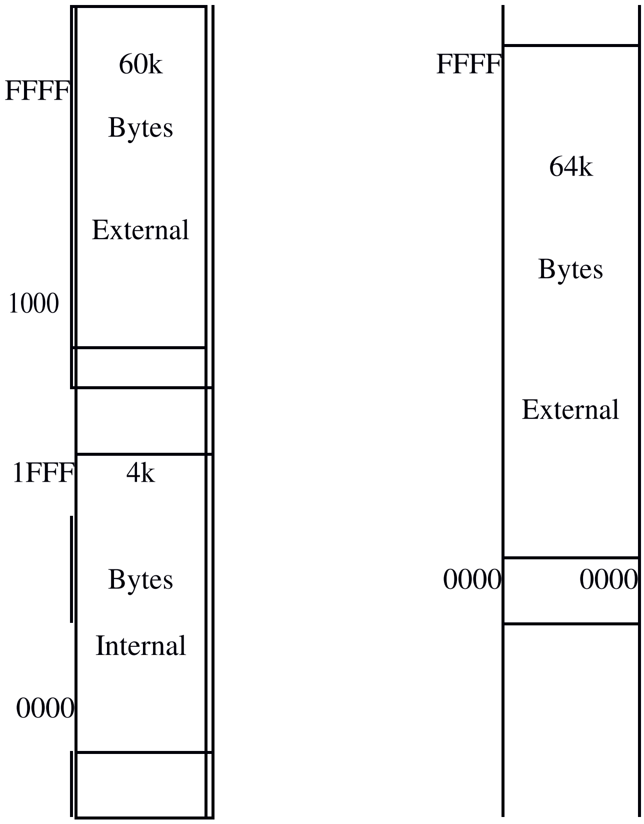

Figure.3.4. Program memory

a)Register banks 0 – 3 (00 – 1FH)

b) Bit addressable area (20H – 2FH)

c) Scratch pad area (30H – 7FH)

3.6. SERIAL INTERFACE

The serial port is full duplex, i.e. it can transmit and receive simultaneously. It is also receive buffered which implies it can begin receiving a second byte before a previously byte has been read from the receive register. The serial port receives and transmits register and reading SBUF accesses a physically separate receive register. This serial interface had four modes of operation:

MODE 0

In this mode of operation the serial data centers and exists through RXD.TXD outputs the shift clock. Eight data bits are transmitted/ received, with the LSB first, the baud rate is fixed at 1/12 of the oscillator frequency. Reception is initialized by the condition RI-0 and REN=1.

MODE 1

In this mode 10 bits (a start bit 0, 8 data bits with LSB first and a stop bit are transmitted through TXD port received through RXD. At the receiving end the stop bits goes into RB8 in the SFR SCON. The baud rate is variable.

MODE 2

In the 2, 16 bits (a start bit 0, 8 data bits (LSDB first), a programmable 9th data bit and a stop bit) are transmitted through TXD or received through RXD.The baud rate is programmable to either 1/32 or 1/64 of the oscillator frequency

MODE 3

The function of mode 3 is same as mode 2 except that the baud rate is variable. Reception is initialized by the incoming start bit if REN=1.

3.7. BAUD RATE CALUCULATIONS

- Baud rate in mode 0 is fixed.
- Mode 0 baud rate=oscillator frequency/12.

- (1 machine cycle=12 clock. cycles).
- The baud rate in mode 2 depends on the value of SMOD bit in PCON.
- Register.
- SMOD=0, baud rate= (1/64) x oscillator frequency.
- SMOD=1baud rate= (1/32) oscillator frequency.

(i.e. mode 2 baud rate= [2(POW) SMOD/64)] x oscillator frequency)

- In the modes 1 and 3, timer 1 over flow rate and the value of SMOD determines the baud rate. Baud rate of mode 1 and 3 = [(2(POW) SMOD/32)] x timer 1 over flow rate.
- The timer 1 interrupt should be disabled in this application.

3.8. UART(Universal Asynchronous Transmitter & Receiver)

One of the microcontroller features making it so powerful is an integrated UART, better known as a serial port. It is a full-duplex port, thus being able to transmit and receive data simultaneously and at different baud rates. Without it, serial data send and receive would be an enormously complicated part of the program in which the pin state is constantly changed and checked at regular intervals. When using UART, all the programmer has to do is to simply select serial port mode and baud rate. When it's done, serial data transmit is nothing but writing to the SBUF register, while data receive represents reading the same register. The microcontroller takes care of not making any error during data transmission.

CHAPTER 4

HARDWARE COMPONENTS

4.1. SOLAR PANEL

4.1.1. HISTORY

Solar cells convert sunlight into electricity.solar cells image by Albert Lozano from Fotolia.com.

Solar panels use photovoltaic cells (solar cells) to convert sunlight into electricity. According to the National Renewable Energy Laboratory (NREL), the PV effect was discovered in 1954 when scientists at Bell Telephone discovered that silicon (an element found in sand) created an electrical charge when exposed to sunlight.

4.1.2. TYPES OF SOLAR PANELS

Placing solar panels on your roof is a sure way to make electricity.Solar Panels image by a less bonaventura from Fotolia.com

Solar panel cells usually consist of mono crystilline or polycrystalline cells. Monocrystilline cells are typically part of more expensive panels and convert more sunlight into electricity than polycrystalline cells. Spending a little more on your solar panel can pay off in the long run.

1. **SOLAR POWER BENEFITS**
    - Solar panel fuel is absolutely free.Sun image by KPICKS from Fotolia.com

      Sunshine is a solar panel's best friend. All you need are sun rays and the electricity will begin to flow. Since the amount of sunlight varies around the world, it is essential to know many hours of good peak hours of sunlight your area receives. That's why position is key when mounting panels on the roof. If positioned in a good location (during the winter or summer months), you should have no problems. Many governments are now offering solar panel rebates to help individuals who invest in solar power.

2. **ECO-FRIENDLY ELECTRICITY**
    - Modern-day living seems to go hand and hand with electricity. Solar panels produce no greenhouse emissions, so they assist in slowing down global warming. It's a great way to utilize clean renewable energy. At a time where everyone is opting to go green to conserve planet Earth, you can rest assured that by using solar panels you would greatly help to reduce your carbon footprint.

A solar panel (photovoltaic module or photovoltaic panel) is a packaged interconnected assembly of solar cells, also known as *photovoltaic cells*. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications.

Because a single solar panel can only produce a limited amount of power, many installations contain several panels. This is known as a photovoltaic array. A photovoltaic installation typically includes an array of solar panels, aninverter, batteries and interconnection wiring.

Photovoltaic systems are used for either on- or off-grid applications, and on spacecraft.

4.1.3. THEORY AND CONSTRUCTION

PV cells connected together in a solar panel.

IN ORDER TO USE THE CELLS IN PRACTICAL APPLICATIONS, THEY MUST BE:

- connected electrically to one another and to the rest of the system
- protected from mechanical damage during manufacture, transport, installation and use (in particular against hail impact, wind and snow loads). This is especially important for wafer-based silicon cells which are brittle.
- protected from moisture, which corrodes metal contacts and interconnections, and for thin-film cells the transparent conductive oxidelayer, thus decreasing performance and lifetime.

Most solar panels are rigid, but semi-flexible ones are available, based on thin-film cells.

Electrical connections are made in series to achieve a desired output voltage and/or in parallel to provide a desired amount of current source capability.

Separate diodes may be needed to avoid reverse currents, in case of partial or total shading, and at night. The p-n junctions of mono-crystalline silicon cells may have adequate reverse current characteristics that these are not necessary. Reverse currents are not only inefficient as they represent power losses, but they can also lead to problematic heating of shaded cells. Solar cells become less efficient at higher temperatures and so it desirable to minimize heat in the panels. Very few modules incorporate any design features to decrease temperature, but installers try to provide good ventilation behind solar panels.

Some recent solar panel designs include concentrators in which light is focused by lenses or mirrors onto an array of smaller cells. This enables the use of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way.

Depending on construction, photovoltaic panels can produce electricity from a range of frequencies of light, but usually cannot cover the entire solar range (specifically, ultraviolet, infrared and low or diffused light). Hence much of the incident sunlight energy is wasted by solar panels, and they can give far higher efficiencies if illuminated with monochromatic light. Therefore another design concept is to split the light into different wavelength ranges and direct the beams onto different cells tuned to those ranges This has been projected to be capable of raising efficiency by 50%. The use of infrared photovoltaic cells has also been proposed to increase efficiencies, and perhaps produce power at night.

Sunlight conversion rates (solar panel efficiencies) can vary from 5-18% in commercial production, typically lower than the efficiencies of their cells in isolation. Panels with conversion rates around 18% are in development incorporating innovations such as power generation on the front and back sides

Fig.4.1 Solar Panel

4.1.4. HISTORY OF SOLAR CELLS

The term "photovoltaic" comes from the Greekφῶς (*phōs*) meaning "light", and "voltaic", meaning electric, from the name of the Italian physicist Volta, after whom a unit of electro-motive force, the volt, is named. The term "photo-voltaic" has been in use in English since 1849.

The photovoltaic effect was first recognized in 1839 by French physicist A. E. Becquerel. However, it was not until 1883 that the first photovoltaic cell was built, by Charles Fritts, who coated the semiconductor selenium with an extremely thin layer of gold to form the junctions. The device was only around 1% efficient. In 1888 Russian physicist Aleksandr Stoletov built the first photoelectric cell (based on the outer photoelectric effect discovered by Heinrich Hertz earlier in 1887). Albert Einstein explained the photoelectric effect in 1905 for which he received the Nobel prize in Physics in 1921. Russell Ohl patented the modern junction semiconductor solar cell in 1946,[2] which was discovered while working on the sries of advances that would lead to the transistor.

4.1.5. THEORY

THE SOLAR CELL WORKS IN THREE STEPS:

1. Photons in sunlight hit the solar panel and are absorbed by semiconducting materials, such as silicon.
2. Electrons (negatively charged) are knocked loose from their atoms, allowing them to flow through the material to produce electricity. Due to the special composition of solar cells, the electrons are only allowed to move in a single direction.
3. An array of solar cells converts solar energy into a usable amount of direct current (DC) electricity.

EFFICIENCY

The efficiency of a solar cell may be broken down into reflectance efficiency, thermodynamic efficiency, charge carrier separation efficiency and conductive efficiency. The overall efficiency is the product of each of these individual efficiencies.

Due to the difficulty in measuring these parameters directly, other parameters are measured instead: thermodynamic efficiency, quantum efficiency, V_{OC} ratio, and fill factor. Reflectance losses are a portion of the quantum efficiency under "external quantum efficiency". Recombination losses make up a portion of the quantum efficiency, V_{OC} ratio, and fill factor. Resistive losses are predominantly categorized under fill factor, but also make up minor portions of the quantum efficiency, V_{OC} ratio.

Crystalline silicon devices are now approaching the theoretical limiting efficiency of 29%.

COST

The cost of solar cell is given per unit of peak electrical power. Manufacturing costs necessarily include the cost of energy required for manufacture. Solar –specific feed in tariffs vary worldwide, and even state by state within various countrieSuch feed-in tariffs can be highly effective in encouraging the development of solar power projects.

High-efficiency solar cells are of interest to decrease the cost of solar energy. Many of the costs of a solar power plant are proportional to the area of the plant; a higher efficiency cell may reduce area and plant cost, even if the cells themselves are more costly. Efficiencies of bare cells, to be useful in evaluating solar power plant economics, must be evaluated under realistic conditions. The basic parameters that need to be evaluated are the short circuit current, open circuit voltage.

A low-cost photovoltaic cell is a thin-film cell intended to produce electrical energy at a price competitive with traditional (fossil fuels and nuclear power) energy sources. This includes second and third generation photovoltaic cells, that is cheaper than first generation (crystalline silicon cells, also called wafer or bulk cells).

Grid parity, the point at which photovoltaic electricity is equal to or cheaper than grid power, can be reached using low cost solar cells. It is achieved first in areas with abundant sun and high costs for electricity such as in California and Japan Grid parity has been reached in Hawaii and other islands that otherwise use diesel fuel to produce electricity. George W. Bush had set 2015 as the date for grid parity in the USA. Speaking at a conference in 2007, General Electric's Chief Engineer predicted grid parity without subsidies in sunny parts of the United States by around 2015

4.1.6. MATERIALS

The Shockley-Queisser limitfor the theoretical maximum efficiency of a solar cell. Semiconductors with band gap between 1 and 1.5eV have the greatest potential to form an efficient cell. (The efficiency "limit" shown here can be exceeded by multijunction solar cells.)

Different materials display different efficiencies and have different costs. Materials for efficient solar cells must have characteristics matched to the spectrum of available light. Some cells are designed to efficiently convert wavelengths of solar light that reach the Earth surface. Light absorbing materials can often be used in multiple physical configurations to take advantage of different light absorption and charge separation mechanisms.

Materials presently used for photovoltaic solar cells include monocrystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride, and copper indium selenide/sulfide.

Many currently available solar cells are made from bulk materials that are cut into wafers between 180 to 240 micrometers thick that are then processed like other semiconductors.

Other materials are made as thin-films layers, organic dyes, and organic polymers that are deposited on supporting substrates. A third group are made from nanocrystals and used as quantum dots (electron-confined nanoparticles). Silicon remains the only material that is well-researched in both *bulk* and *thin-film* forms.

LIFESPAN

Most commercially available solar cells are capable of producing electricity at least twenty years without a significant decrease in efficiency. The typical warranty given by panel manufacturers. Where in the output shall not fall below a specified percentage of rated capacity. ολαρ

RESEARCHTOPICS

There are currently many research groups active in the field of photovoltaic in universities and research institutes around the world. This research can be divided into three areas: making current technology solar cells cheaper and/or more efficient to effectively compete with other energy sources; developing new technologies based on new solar cell architectural designs; and developing new materials to serve as light absorbers and charge carriers.

Fig.4.2 Applications

Solar panels are eco-friendly electric generators. They convert sunlight into electrical energy. Solar panels have no moving parts, put out zero emissions and require very little maintenance. Most panels have a life expectancy of 25 to 30 years or more. As an added bonus, they will generate free electricity the whole time with no bills or hidden fees included.

4.2. DRIVER IC

4.2.1. Working theory of H-bridge

The name H-bridge is derived from the actual shape of the switching circuit which controls the motion of the motor. It is also known as “Full Bridge”. Basically there are four switching elements in the H-bridge as shown in the figure below.

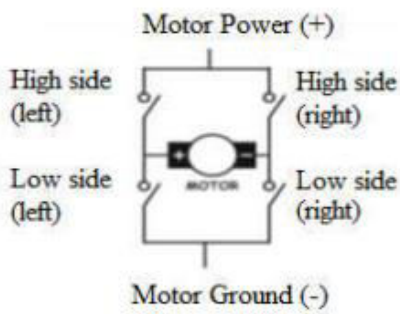

Figure.4.3. H-Bridge

As shown in the above figure there are four switching elements named as “High side left”, “high side right”, “low side left”, “low side right”. When these switches are turned on in pairs motor changes its direction accordingly. Like if we switch on high side left and low side right then the motor rotates in forward direction. As the current flows from P\power supply through the motor coil goes to the ground via switch low side right. This is the figure shown below.

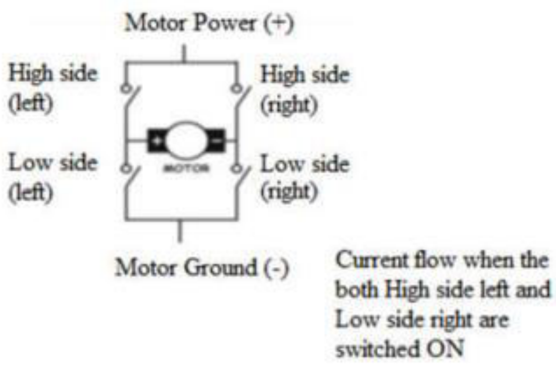

Figure.4.4. Operation in H-Bridge

Similarly if we switch on the low side left and high side right the current flows in opposite direction and motor runs in forward direction. This is the basic working of H-Bridge Motor.

4.3. L293D DUAL H-BRIDGE MOTOR DRIVER

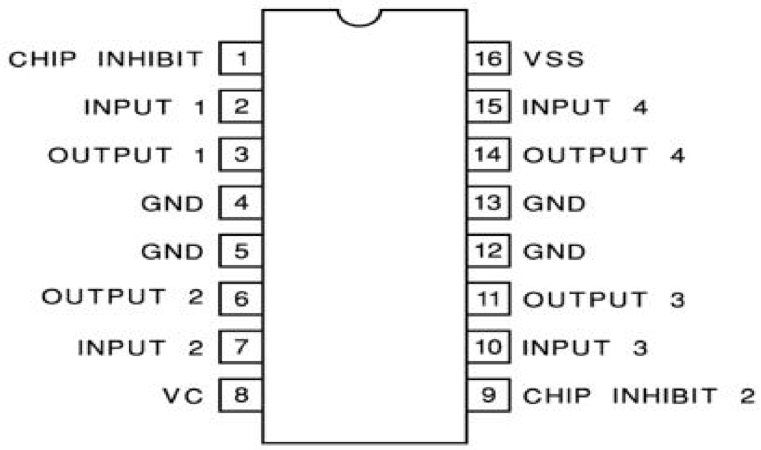

Fig.4.5. L293D PIN Diagram

L293D is a dual H-Bridge motor Driver, so with one IC we can interface two DC motors which can be controlled in both clock wise and anticlockwise directions when we have motor with fixed direction of motion.

We can also make use of all the four I/o's to connect up to four DC motors. L293D has an output current of 600mA and peak output current of 1.2A per channel. Moreover the protection of the circuit from back EMF output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5 V to 36V, which has made L293D as the best choice for DC motor Driver.

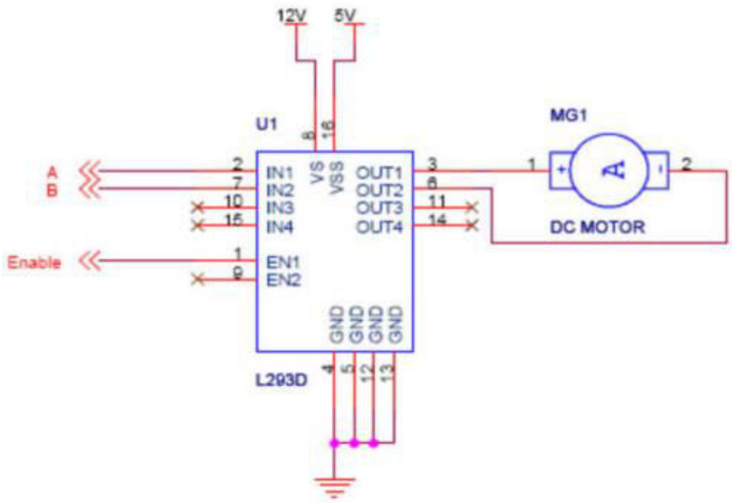

Figure.4.6. L293D PIN Diagram with DC motor

Truth table

A	B	Description
0	0	Motor stops or Breaks
0	1	Motor runs Anti clockwise
1	0	Motor runs clockwise
1	1	Motor stops Anti or Breaks
For this the enable has to set (1). Motor Power is mentioned 12V, but we can connect power according to our motors.		

Table.4.1. Truth table of motor description.

As we see in the circuit three pins are needed for interfacing DC motor (A, B, Enable). If we want the output to be enabled completely then we can connect the enable to VCC and only two pins needed from the micro controller. As per the truth mentioned in the image above it's fairly simple program to the micro controller. It is also clear from the BJT circuit and L293D the programming will be same for both of them, just keep in mind of the allowed combinations of the A and B.

Figure.4.7. L293 motor driver

4.4. DC MOTOR

4.4.1. Principle of operation

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion. Let's start by looking at a simple 2-pole DC electric motor (here red represents a magnet or winding with a "North" polarization, while green represents a magnet or winding with a "South" polarization).

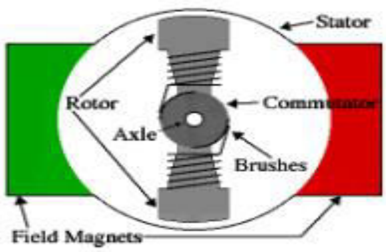

Figure.4.8. DC Motor

Every DC motor has six basic parts -- axle, rotor (a.k.a., Armature), stator, commutator, field magnet(s), and brushes. In most common DC motors (and all that Beamers will see), the external magnetic field is produced by high-strength permanent magnets1 . The stator is the stationary part of the motor -- this includes the motor casing, as well as two or more permanent magnet pole pieces. The rotor (together with the axle and attached commutator) rotates with respect to the stator. The rotor consists of windings (generally on a core), the windings being electrically connected to the commutator. The above diagram shows a common motor layout -- with the rotor inside the stator (field) magnets.

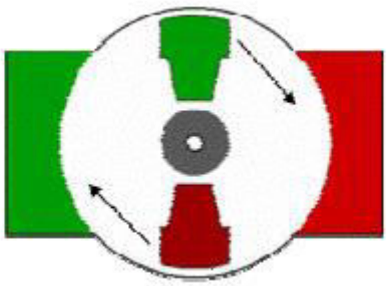

Figure.4.9. Rotation Axes

So since most small DC motors are of a three-pole design, let's tinker with the workings of one via an interactive animation (JavaScript required):

You'll notice a few things from this -- namely, one pole is fully energized at a time (but two others are "partially" energized). As each brush transitions from one commutator contact to the next, one coil's field will rapidly collapse, as the next coil's field will rapidly charge up (this occurs within a few microsecond). We'll see more about the effects of this later, but in the meantime you can see that this is a direct result of the coil windings' series wiring: There's probably no better way to see how an average DC motor is put together, than by just opening one up. Unfortunately this is tedious work, as well as requiring the destruction of a perfectly good motor.

Luckily for you, I've gone ahead and done this in your stead. The guts of a disassembled Mabuchi FF-030-PN motor (the same model that Solar robotic cells) are available for you to see here (on 10 lines / cm graph paper). This is a basic 3-pole DC motor, with 2 brushes and three commutated contacts.

The use of an iron core AVR nature (as in the Mabuchi, above) is quite common, and has a number of advantages2 . First off, the iron core provides a strong, rigid support for the windings -- a particularly important consideration for high-torque motors. The core also conducts heat away from the rotor windings, allowing the motor to be driven harder than might otherwise be the case. Iron core construction is also relatively inexpensive compared with other construction types.

But iron core construction also has several disadvantages. The iron Armature has a relatively high inertia which limits motor acceleration. This construction also results in high winding inductances which limit brush and commutator life.

In small motors, an alternative design is often used which features a 'coreless' Armature winding. This design depends upon the coil wire itself for structural integrity. As a result, the Armature is hollow, and the permanent magnet can be mounted inside the rotor coil. Coreless DC motors have much lower Armature inductance than iron-core motors of comparable size, extending brush and commutator life.

Figure.4.10. Parts of DC motor

The coreless design also allows manufacturers to build smaller motors; meanwhile, due to the lack of iron in their rotors, coreless motors are somewhat prone to overheating. As a result, this design is generally used just in small, low-power motors. To Beamers will most often see coreless DC motors in the form of pager motors. Coreless motor can be instructive -- in this case, my hapless victim was a cheap pager vibrator motor. The guts of this disassembled motor are available for you to see here (on 10 lines / cm graph paper). This is (or more accurately, was) a 3-pole coreless DC motor.

4.5. BLUETOOTH

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz[3]) from fixed and mobile devices, and building personal area networks (PANs). Invented by telecom vendor Ericsson in 1994,[4] it was originally conceived as a wireless alternative to RS-232 data cables.

Bluetooth is managed by the Bluetooth Special Interest Group (SIG), which has more than 30,000 member companies in the areas of telecommunication, computing, networking, and consumer electronics.[5] The IEEE standardized Bluetooth as **IEEE 802.15.1**, but no longer maintains the standard. The Bluetooth SIG oversees development of thespecification, manages the qualification program, and protects the trademarks.[6] A manufacturer must meet Bluetooth SIG standards to market it as a Bluetooth device.[7] A network of patents apply to the technology, which are licensed to individual qualifying devices.

Bluetooth operates at frequencies between 2402 and 2480 MHz, or 2400 and 2483.5 MHz including guard bands 2 MHz wide at the bottom end and 3.5 MHz wide at the top.[15] This is in the globally unlicensed (but not unregulated) industrial, scientific and medical (ISM) 2.4 GHz short-range radio frequency band. Bluetooth uses a radio technology called frequency-hopping spread spectrum. Bluetooth divides transmitted data into packets, and transmits each packet on one of 79 designated Bluetooth channels. Each channel has a bandwidth of 1MHz. It usually performs 800 hops per second, with Adaptive Frequency-Hopping (AFH) enabled.[15] Bluetooth Low Energy uses 2 MHz spacing, which accommodates 40 channels.[16]

Originally, Gaussian frequency-shift keying (GFSK) modulation was the only modulation scheme available. Since the introduction of Bluetooth 2.0+EDR, π/4-DQPSK (differential quadrature phase shift keying) and 8DPSK modulation may also be used between compatible devices. Devices functioning with GFSK are said to be operating in basic rate (BR) mode where an instantaneous bit rate of 1Mbit/s is possible. The term Enhanced Data Rate (EDR) is used to describe π/4-DPSK and 8DPSK schemes, each giving 2 and 3Mbit/s respectively. The combination of these (BR and EDR) modes in Bluetooth radio technology is classified as a "BR/EDR radio".on low-cost transceiver microchips in each device.[17] Because the devices use a radio (broadcast) communications system, they do not have to be in visual line of sight of each other; however, a quasi optical wireless path must be viable.[5] Range is power-class-dependent, but effective ranges vary in practice. See the table "Ranges of Bluetooth Devices by Bluetooth is a standard wire-replacement communications protocol primarily designed for low-power consumption, with a short range based Class".

Officially Class 3 radios have a range of up to 1metre (3 ft), Class 2, most commonly found in mobile devices, 10metres (33 ft), and Class 1, primarily for industrial use cases,100metres (300 ft).[2] Bluetooth Marketing qualifies that Class 1 range is in most cases 20–30metres (66–98 ft), and Class 2 range 5–10metres (16–33 ft).[1]

Bluetooth version	Maximum speed[*citation needed*]	Maximum range[*citation needed*]
3.0	25Mbit/s[18]	10 meters (33 ft)
4.0	25Mbit/s[18]	60 meters (200 ft)[18]
5	50Mbit/s	240 meters (800 ft)

Table.4.2. Bluetooth versions

Figure.4.11.Bluetooth module

CHAPTER 5

SOFTWARES

5.1. KEIL SOFTWARE

The micro vision IDE from keil combines project management, facilities, source code editing, and program debugging and complete simulation in one powerful environment.

Installing the Keil software on a Windows PC

- Insert the CD-ROM in your computer‘s CD drive
- On most computers, the CD will ―auto run‖, and you will see the Keil installation menu. If the menu does not appear, manually double click on the Setup icon, in the root directory: you will then see the Keil menu.
- On the Keil menu, please select ―Install Evaluation Software‖. (You will not require a license number to install this software).
- Follow the installation instructions as they appear.

Loading the Projects

The example projects for this book are NOT loaded automatically when you install the Keil compiler.

These files are stored on the CD in a directory ―/Pont‖. The files are arranged by chapter: for example, the project discussed in Chapter 3 is in the directory ―/Pont/Ch03_00-Hello‖.Rather than using the projects on the CD (where changes cannot be saved), please copy the files from CD onto an appropriate directory on your hard disk.

Configuring the Simulator

Open the Keil Vision2

Go to Project – Open Project and browse for Hello in Ch03_00 in Pont and open it.

Go to Project – Select Device for Target _Target1‘

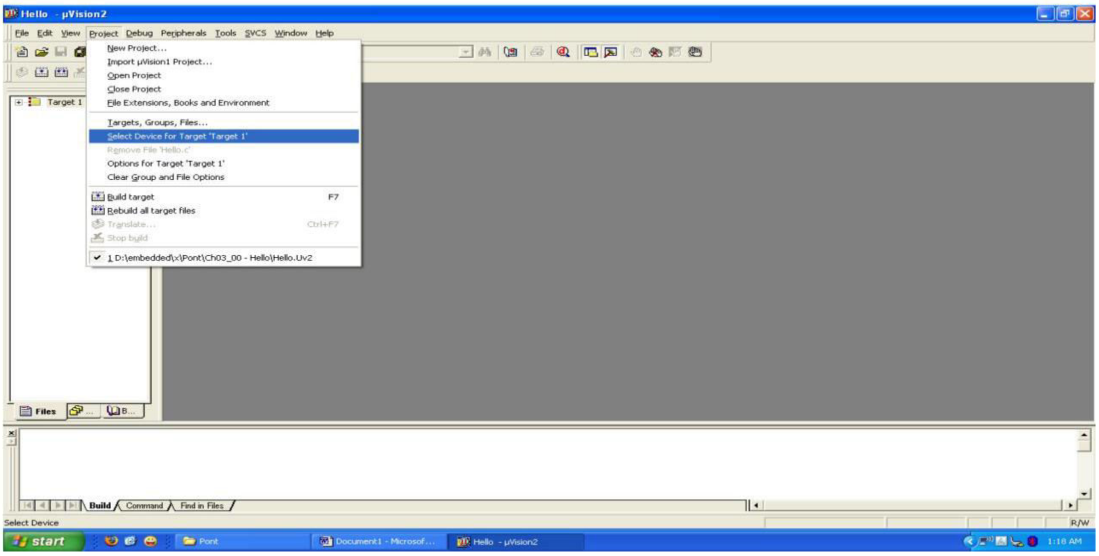

Figure.5.1. To select device for Target 1

Select 8052(all variants) and click OK

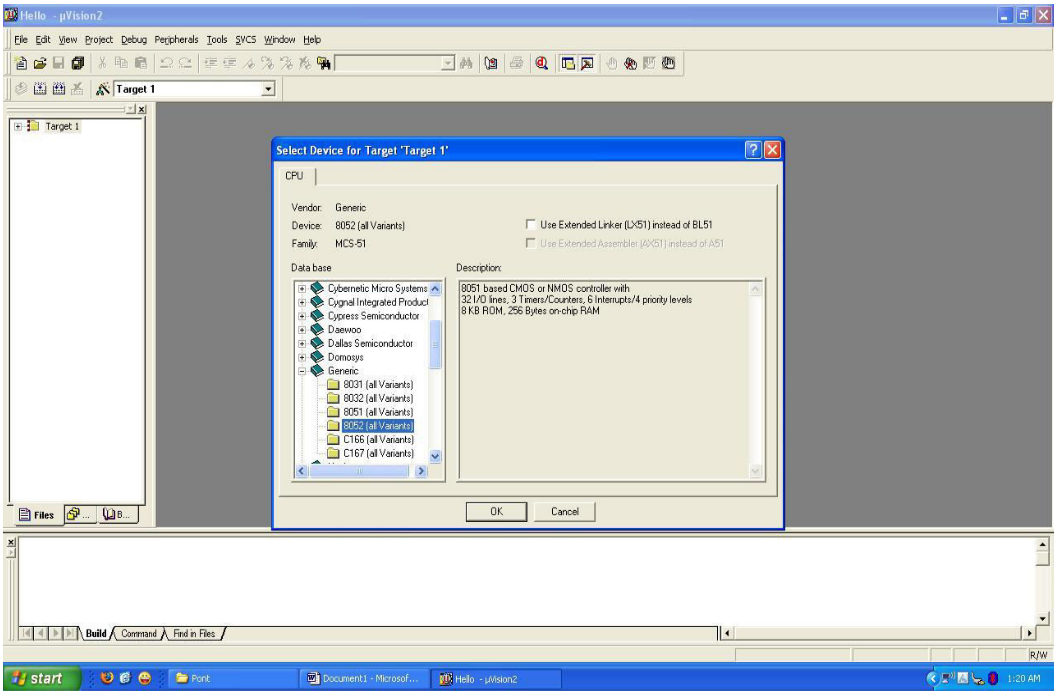

Figure.5.2. To select 8052

Now we need to check the oscillator frequency:

Go to project – Options for Target _Target1‘

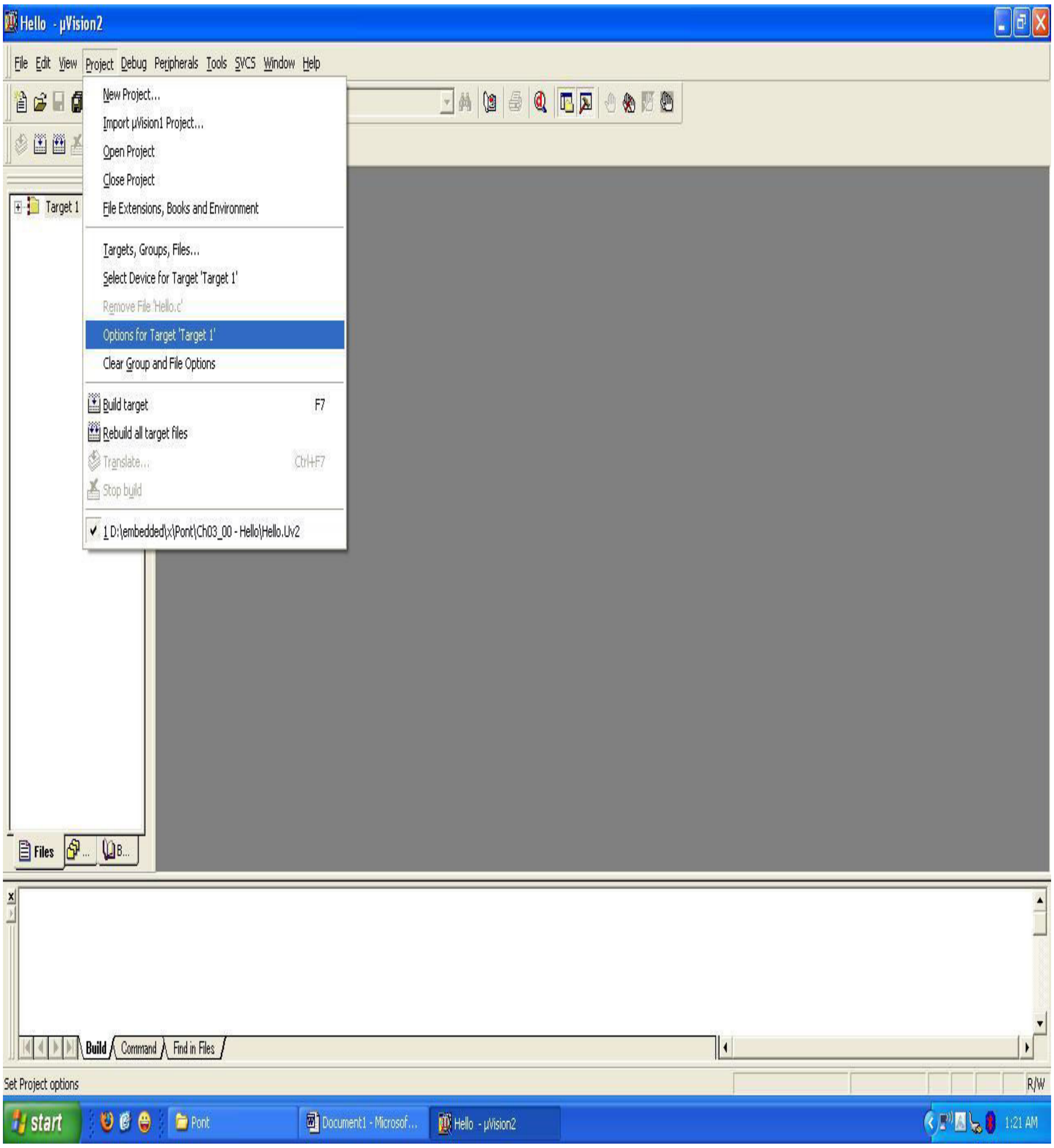

Figure.5.3. To Select Options for Target 1

Make sure that the oscillator frequency is 11.05

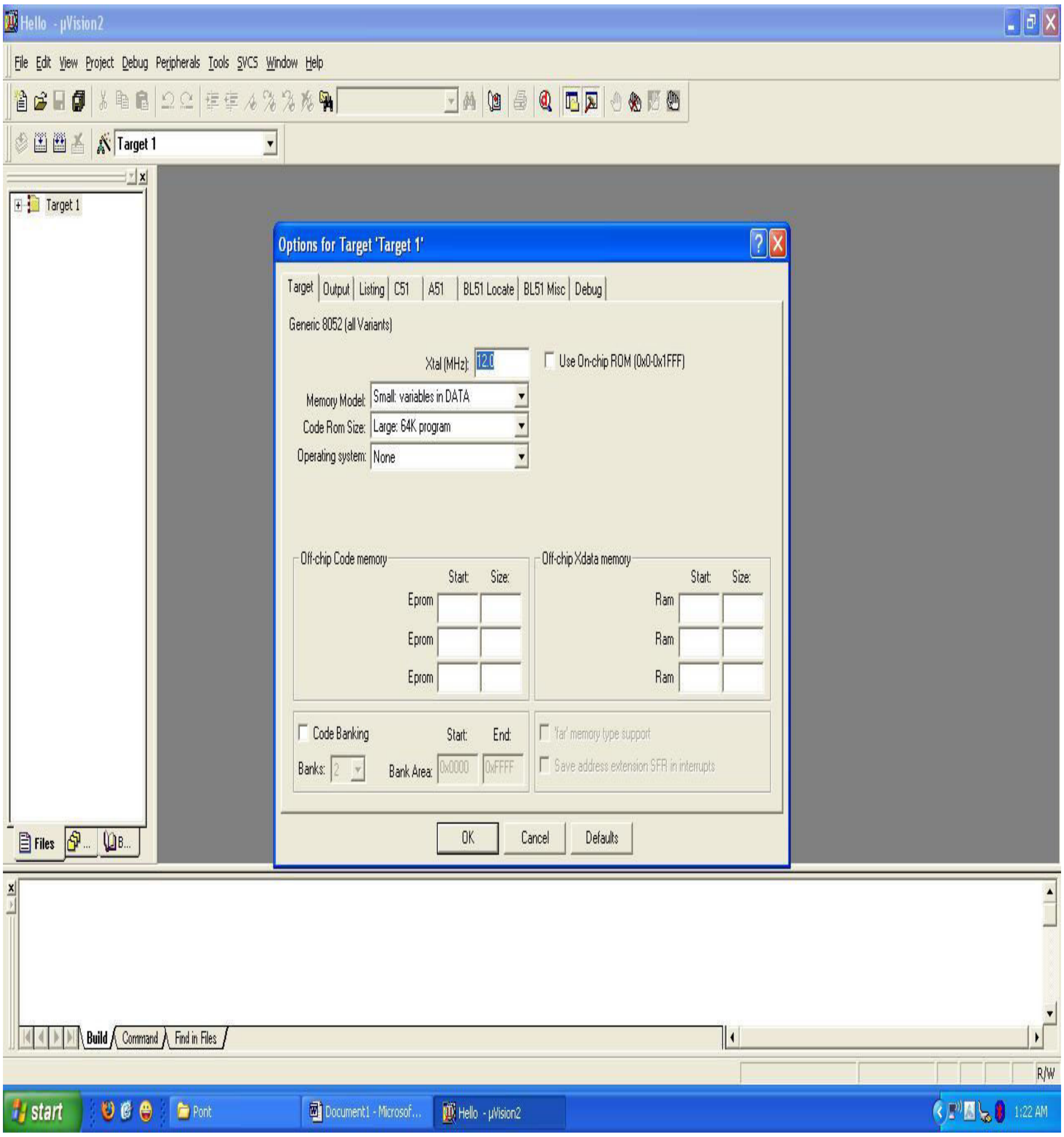

Figure.5.4. Selecting the oscillator frequency

Building the Target

Build the target as illustrated in the figure below

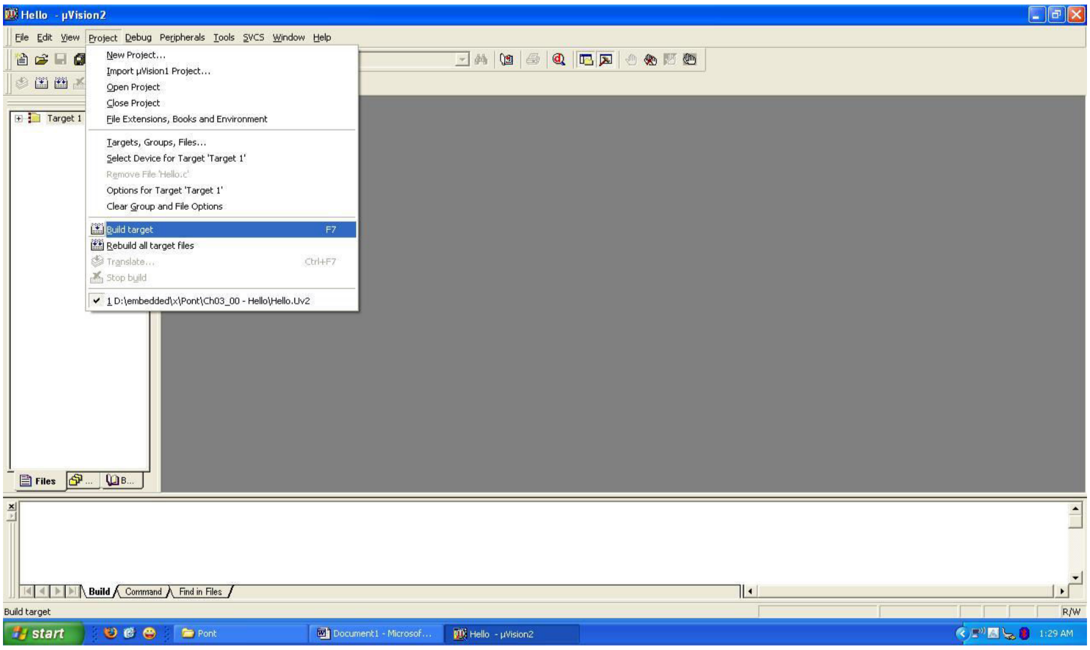

Figure.5.5. To build the target

Running the Simulation

Having successfully built the target, we are now ready to start the debug session and run the simulator.

First start a debug session

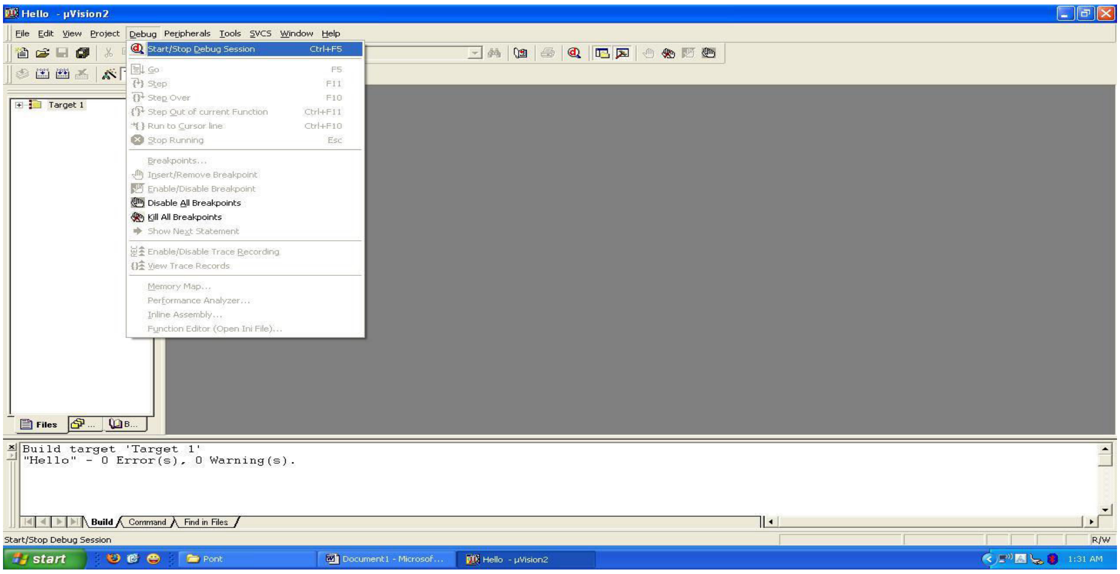

Figure.5.6. To debug the target

The flashing LED we will view will be connected to Port 1. We therefore want to observe the activity on this port

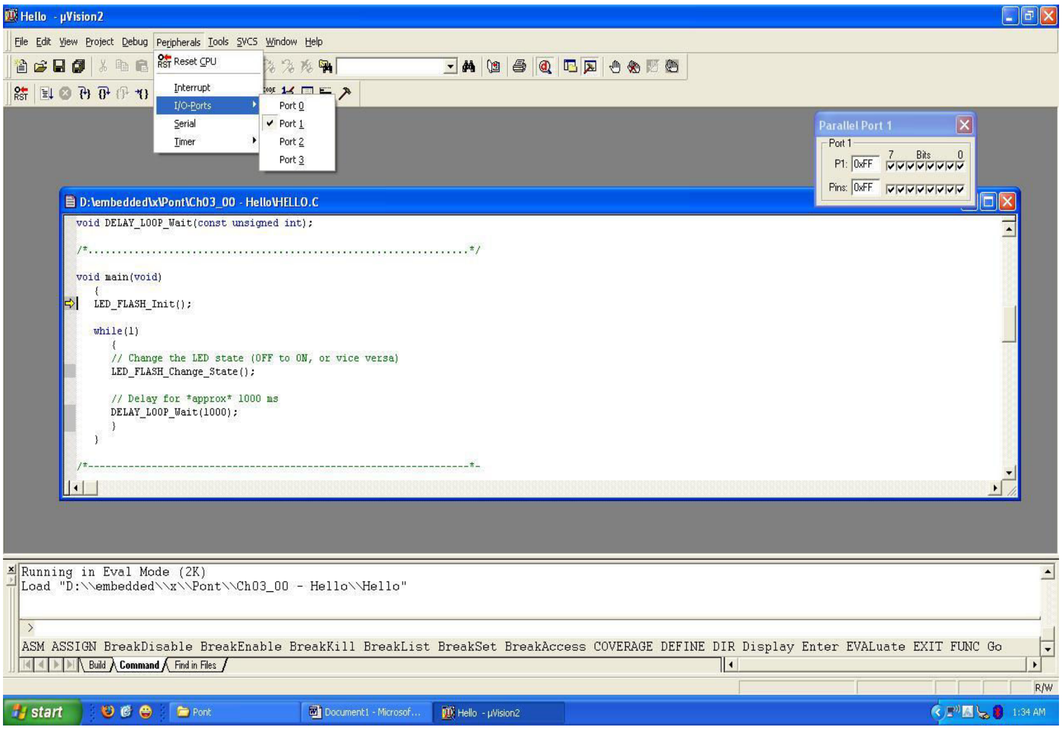

Figure.5.7. To select the port 1

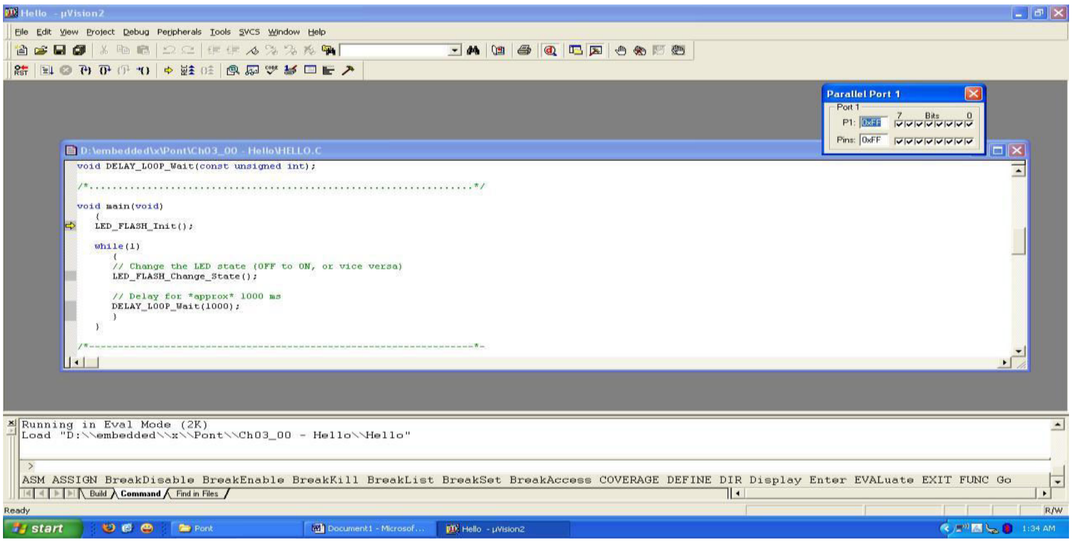

Figure.5.8. To see the output of LED

To ensure that the port activity is visible, we need to start the _periodic window update‘ flag

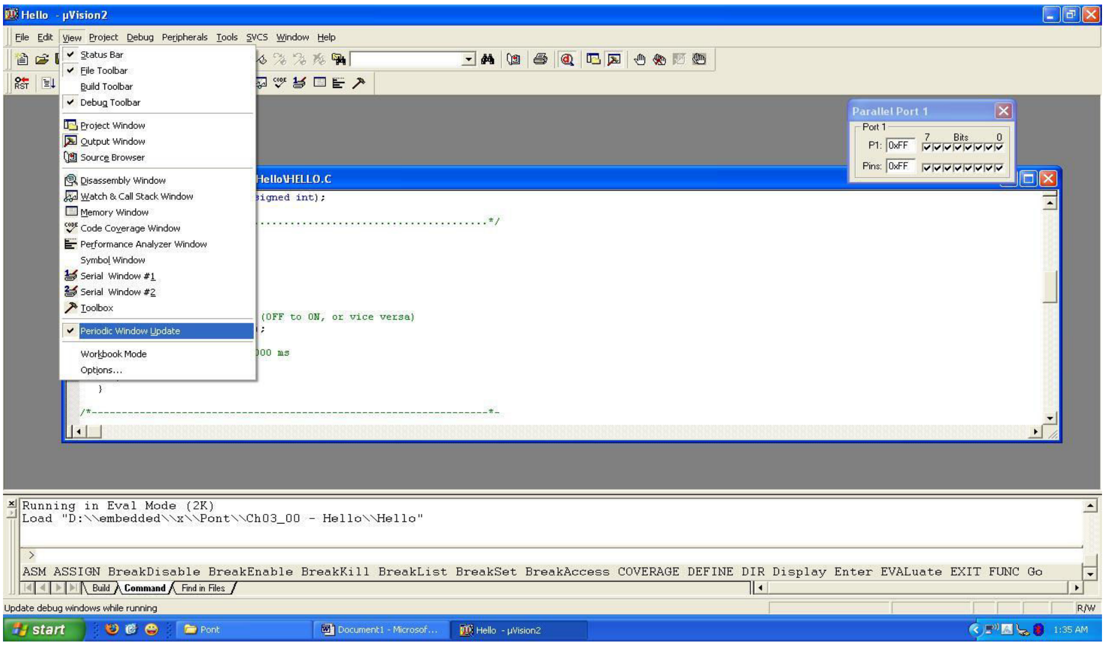

Figure.5.9. To start the periodic window update flag

Go to Debug - Go

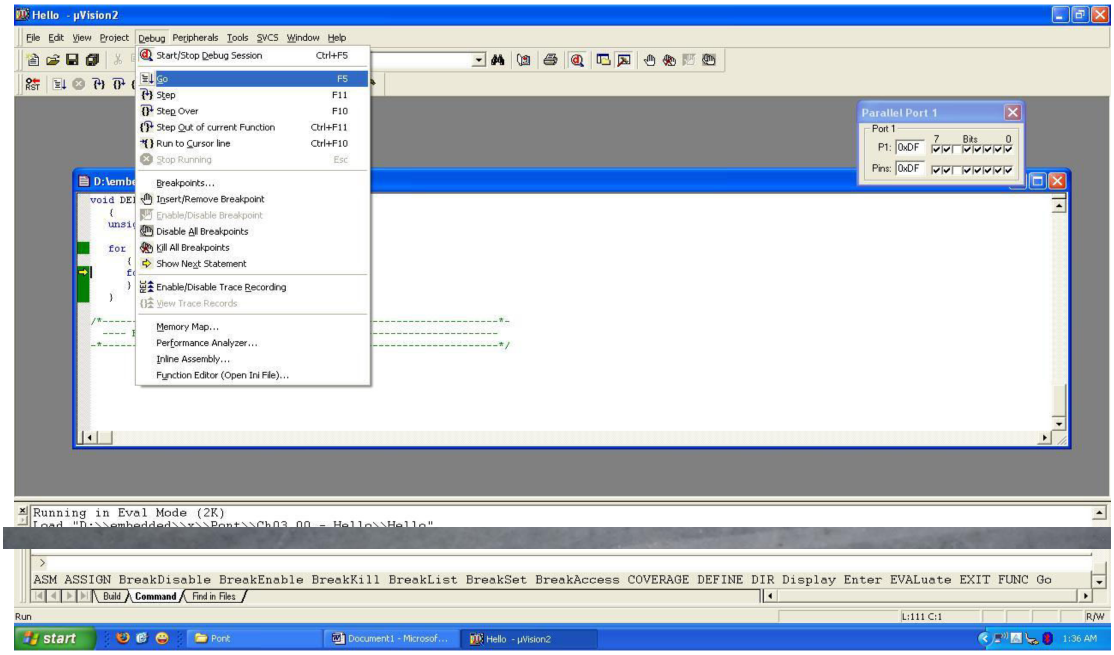

Figure.5.10. To debug the code

While the simulation is running, view the performance analyzer to check the delay durations

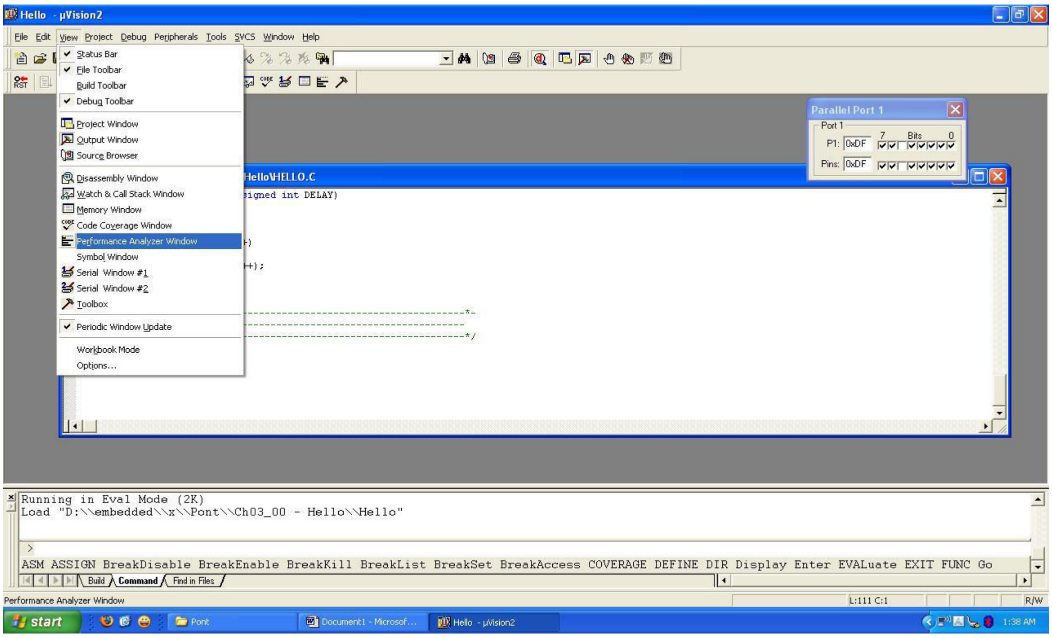

Figure.5.11. To simulate the code

Go to Debug – Performance Analyzer and click on it

Double click on DELAY-LOOP-Wait in Function Symbols: and click Define button

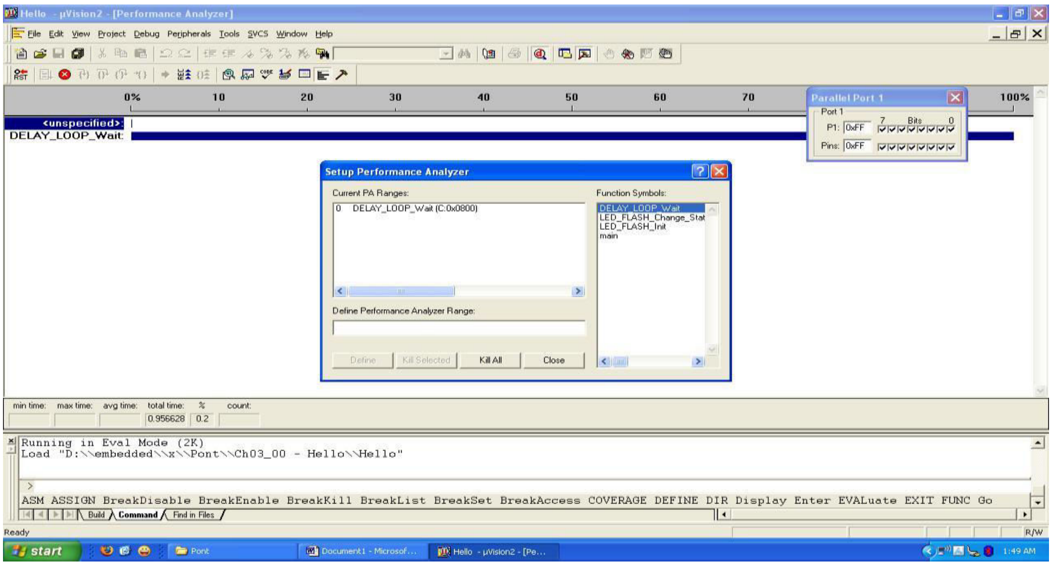

Figure.5.12. To provide the delay loop

CHAPTER 6

RESULTS

6.1. RESULTS

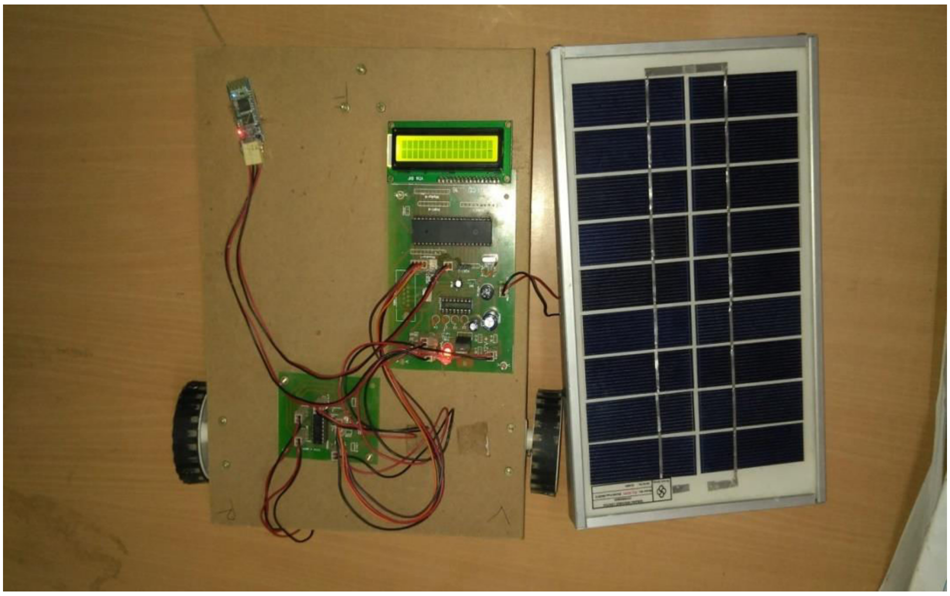

Figure.6.1. Photocopy of Solar based robot using Bluetooth

CHAPTER 7

CONCLUSION AND FUTURE SCOPE

7.1. CONCLUSION

Making a self-sustainable human-independent robotic system develops two main ideas. The first one is creating a robot that can work on some projects without any human help. The second one is using a renewable power source as main energy supplier. Combining these two concepts, very powerful robotic systems can be assembled contributing to the whole aspect of the life in future.

7.2. FUTURE SCOPE

We implemented an initial prototype of the robotic vehicle that can be used in order to manage the networks in the future. In our future work, we want to collaborate our robotic vehicle with other monitoring tools such as Nagios, SNMP, PRTG so that our robotic vehicle can be notified by those tools in order to rescue the networks from being offline for a longtime. Our next future task is to facilitate this robot with wireless communication such as ZigBee and utilize the robotic vehicle in the disaster area in order to assist the rescue team to support their management operation. Specifically, our future endeavor will go on to implement the robotics vehicle that can autonomously move in the outdoor field in order to locate and accurately navigate the server position on the basis of GPS, GIS and GPRS information.

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    - MuhammadAliMazidi
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    - Kenneth J. Ayala
3. Fundamentals of Micro processors and Micro computers
    - B. Ram
4. Electronic Components
    - D.V. Prasad

APPENDIX

SOURCE CODE

```
#include <LiquidCrystal.h>

#include <SoftwareSerial.h>


LiquidCrystallcd(A0,A1,A2,A3,A4,A5);

const int l1 = 2, l2 = 3,l3 = 4, l4 = 5,metal=8;

#define echoPin 7 // Echo Pin

#define trigPin 6 // Trigger Pin



intmaximumRange = 200; // Maximum range needed

intminimumRange = 0; // Minimum range needed

long duration, distance; // Duration used to calculate distance


void setup()

{


pinMode(trigPin, OUTPUT);

pinMode(echoPin, INPUT);

pinMode(l1, OUTPUT);delay(100);

pinMode(l2, OUTPUT);delay(100);

pinMode(l3, OUTPUT);delay(100);

pinMode(l4, OUTPUT);delay(100);

digitalWrite(l1,LOW);delay(100);

digitalWrite(l2,LOW);delay(100);

digitalWrite(l3,LOW);delay(100);

digitalWrite(l4,LOW);delay(100);

pinMode(metal, INPUT);delay(100);
```

```
Serial.begin(9600); // connect serial


lcd.begin(16,2);

lcd.print("Hello World....");delay(1000);

}

void loop()

{

lcd.clear();lcd.print("READY TO RECEIVE");delay(1000);


digitalWrite(trigPin, LOW);

delayMicroseconds(2);


digitalWrite(trigPin, HIGH);

delayMicroseconds(10);


digitalWrite(trigPin, LOW);

duration = pulseIn(echoPin, HIGH);


 //Calculate the distance (in cm) based on the speed of sound.

distance = duration/58.2;


Serial.print("distance: ");Serial.println(distance);

if(distance<50)

  {


digitalWrite(l1,LOW);digitalWrite(l2,LOW);digitalWrite(l3,LOW);digitalWrite(l4,LOW);delay(1000);

  }
```

```
int m=digitalRead(metal);
if(m==LOW)
  {
lcd.clear();lcd.print("GAS DETECTED");Serial.print("GAS
DETECTED\r\n");delay(100);
  }
else
  {
lcd.clear();lcd.print("NORMAL GAS LEVELS");delay(100);
  }
while(Serial.available()>0)
{
String siva=Serial.readString();

intlen=siva.length();
intourdata = siva.indexOf("data:");
//Serial.print("OUR DATA=");

//Serial.print(siva[ourdata+5]);
//Serial.print(siva[ourdata+6]);
//Serial.print(siva[ourdata+7]);
//Serial.print(siva[ourdata+8]);

lcd.clear();lcd.print("DATA:");

lcd.print(siva[ourdata+5]);delay(1000);
lcd.print(siva[ourdata+6]);delay(1000);
lcd.print(siva[ourdata+7]);delay(1000);
```

```
lcd.print(siva[ourdata+8]);delay(1000);

if((siva[ourdata+5]=='2')&&(siva[ourdata+6]=='2')&&(siva[ourdata+
7]=='2')&&(siva[ourdata+8]=='2'))
{
lcd.clear();lcd.print("FRONT");delay(1000);
digitalWrite(l1,HIGH);digitalWrite(l2,LOW);digitalWrite(l3,HIGH);
digitalWrite(l4,LOW);delay(1000);
}

if((siva[ourdata+5]=='4')&&(siva[ourdata+6]=='4')&&(siva[ourdata+
7]=='4')&&(siva[ourdata+8]=='4'))

{
lcd.clear();lcd.print("LEFT");delay(1000);
digitalWrite(l1,LOW);digitalWrite(l2,LOW);digitalWrite(l3,HIGH);d
igitalWrite(l4,LOW);delay(2000);
digitalWrite(l1,LOW);digitalWrite(l2,LOW);digitalWrite(l3,LOW);di
gitalWrite(l4,LOW);delay(1000);
}

if((siva[ourdata+5]=='5')&&(siva[ourdata+6]=='5')&&(siva[ourdata+
7]=='5')&&(siva[ourdata+8]=='5'))
{
lcd.clear();lcd.print("STOP");delay(1000);
digitalWrite(l1,LOW);digitalWrite(l2,LOW);digitalWrite(l3,LOW);di
gitalWrite(l4,LOW);delay(1000);
}
```

```
if((siva[ourdata+5]=='6')&&(siva[ourdata+6]=='6')&&(siva[ourdata+
7]=='6')&&(siva[ourdata+8]=='6'))
{
lcd.clear();lcd.print("RIGHT");delay(1000);
digitalWrite(l1,HIGH);digitalWrite(l2,LOW);digitalWrite(l3,LOW);d
igitalWrite(l4,LOW);delay(2000);

digitalWrite(l1,LOW);digitalWrite(l2,LOW);digitalWrite(l3,LOW);di
gitalWrite(l4,LOW);delay(1000);
}



if((siva[ourdata+5]=='8')&&(siva[ourdata+6]=='8')&&(siva[ourdata+
7]=='8')&&(siva[ourdata+8]=='8'))
{
lcd.clear();lcd.print("STOP");delay(1000);
digitalWrite(l1,LOW);digitalWrite(l2,HIGH);digitalWrite(l3,LOW);d
igitalWrite(l4,HIGH);delay(1000);
}
}
}
```