Gokaraju Rangaraju Institute of Engineering and Technology

Bachelor of Technology

(Electronics and Communication Engineering)

Industry Oriented Mini Project

Title:

HC-05 Bluetooth and Relay based Android Mobile Controlled 12 Volt DC Fan with ATmega16

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# Contents

1. DESIGN DOCUMENT

- The mentioned project aims to provide the user with the facility of controlling a 12 Volt DC fan with a click of a button wirelessly. An Android Application should be installed in user's mobile or tablet to control the fan. Using this Android Application user can send the commands to the Wireless module to control the electrical load.

- As the microcontroller works with 5 Volt DC, an Adapter is used to convert 230 Volt AC to 9 Volt DC. This 9 Volt DC is given to the PCB through a DC Barrel Jack, and then this voltage is converted to 5 Volt DC using a 7805 Voltage regulator. To avoid the oscillations and electrical noise and also to smoothen up the ripples at the output, capacitors are used at input as well as output side of voltage regulator.

- The HC-05 Bluetooth Module is interfaced serially to the Microcontroller. Some Diagnostic LED's are used to indicate some particular purposes. Eagle PCB CAD software is used for the design of the single layer custom board.

  This Project consists of following components:

  - ATMega16

  - HC-05 Bluetooth Module
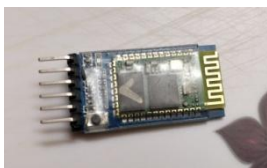
  - 7805 Voltage Regulator

  - 5V Relay

- *USBASP Programmer*

- *1N4148 Signal Diode*

- *10uF,25V Tantalum capacitor*

- *3 pin PBT Connectors*

- *DC Barrel Jack*
- *Mini Pushbutton Switch*
- *16MHz Crystal*
- *1N4007 diode*
- *BC547 NPN transistor*
- *100uF,25V Aluminium Electrolytic Capacitor*
- *22pF Ceramic Capacitors*
- *10kΩ,1/4 watt Resistors*
- *IC Holder*
- *Female Headers*
- *ICSP headers*
- *5mm Red LED's*
- *230VAC-9VDC Adapter*
- *12 Volt Battery*
- *12 Volt DC fan*

HARDWARE:

The Custom built board consists of the following resources:

- *MICROCONTROLLER: ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing) architecture with 131 powerful instructions. Atmega16 can work on a maximum frequency of 16MHz. ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the designer of the system to optimize power consumption versus processing speed.*

  - *POWER SUPPLY: As the microcontroller works with 5 Volt DC, an Adapter is used to convert 230 Volt AC to 9 Volt DC. This 9 Volt DC is given to the PCB through a DC Barrel Jack, and then this voltage is converted into 5 Volt DC using a 7805 Voltage regulator. To avoid the oscillations and electrical noise and also to smoothen up the ripples at the output, capacitors are used at input as well as output side of voltage regulator.*

- *RELAY: Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. Thus a small sensor circuit can drive, say, a fan or an electric bulb. A 5 Volt operated relay is used in this project with Normally Open (NO)/Normally Closed (NC) contacts. The NO contacts are brought onto terminal blocks.*

- *BLUETOOTH MODULE: In this project, HC-05 Bluetooth Module is used. This Module is interfaced serially to the microcontroller.*
- *Some Diagnostic LED's are used to indicate some particular purposes.*
- *Eagle PCB CAD software is used for the design of the single layer custom board.*

Custom built PCB
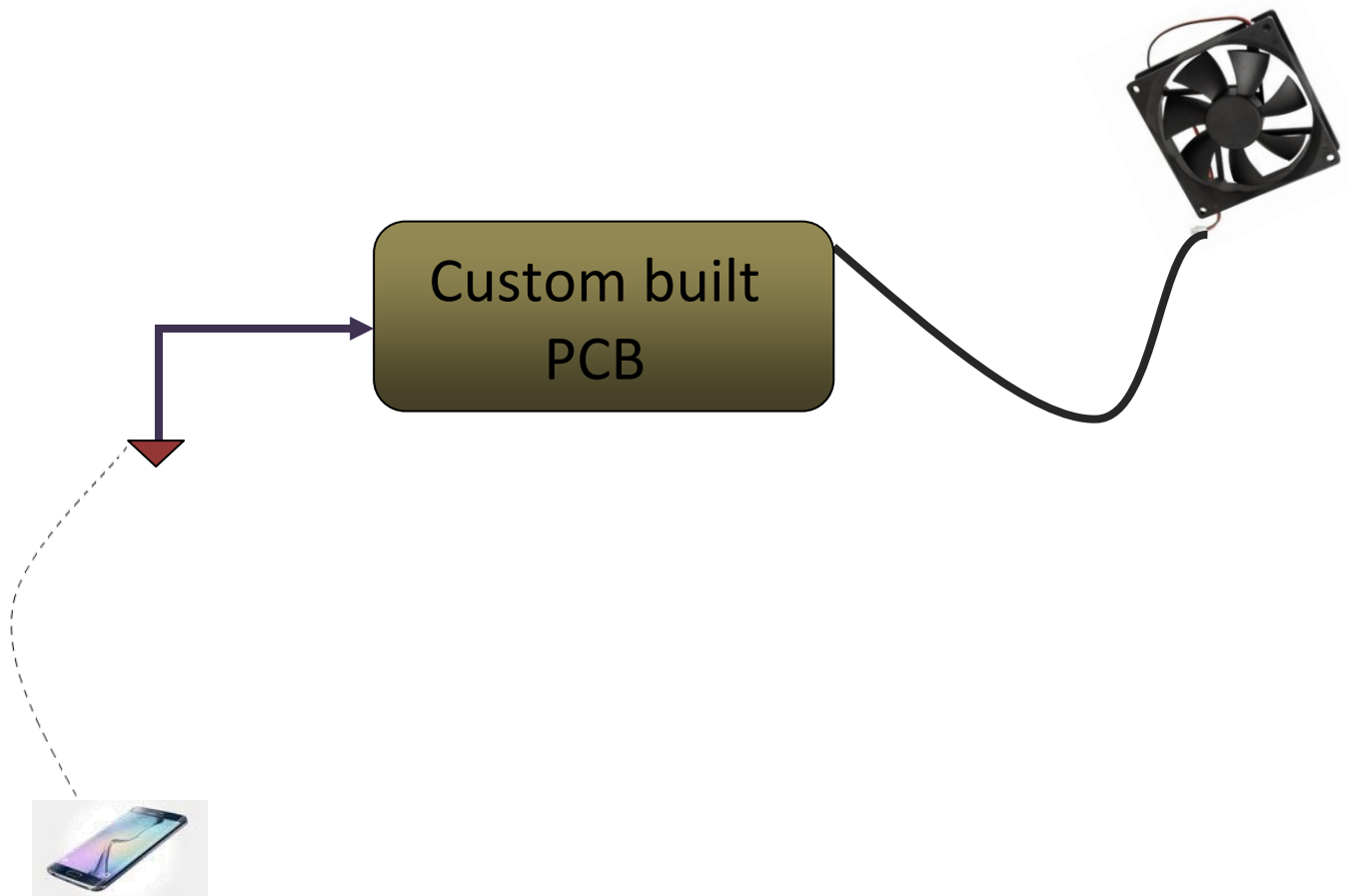
Mobile phone with custom app

SOFTWARE:

FIRMWARE:

The Firmware is written using ATMEL Studio 7.0 IDE (Free software which can be downloaded from the Internet). The Firmware will be burnt into the Flash memory of the microcontroller using an USBASP AVR programmer by providing suitable connections. The programming language used in this firmware is Embedded 'C'. The firmware will function as below:

- *Read the switch on/off command received by the Bluetooth module from the mobile app.*
- *Switch on/off the fan by operating the 5 Volt relay.*

2. PROJECT SPECIFICATIONS

Functional Requirements:

- *The System must be able to control a 12 Volt DC Fan using Android Mobile.*

- *The System must be able to detect signals or take inputs from the Android Mobile.*

- *The System must be able to process the commands from the user.*

- *The System must be able to reset, once its corresponding switch is pressed.*

- *The System must not interfere with other Wireless Modules.*

- *The System must be able to provide the access to Serial Communication.*

- *The System must be able to provide accurate and precise values.*

- *The System must be able to maintain consistency.*

- *The System must be able to provide greater convenience to the Customer.*

- *The overall System must be fast enough to realize the true power of Wireless technology.*

Non-functional Requirements:

- *The System must provide a User-friendly interface on the host side, so that the devices can be setup, monitored and controlled.*

- *The power consumed by the system should be low.*

- *The System must be cost effective in order to justify its application in home automation.*

- *The System must be easily configurable.*

- *The System should be scalable so that new devices can be integrated on it.*

- *The System must be reliable, portable and flexible in nature.*

- *The System must have high efficiency and high performance.*

- *The System must be heat resistant.*

- *External wiring required should be minimal.*

- *The System must have a long lasting battery to survive.*

3. DELIVERABLES

Hardware:

- Custom built PCB board
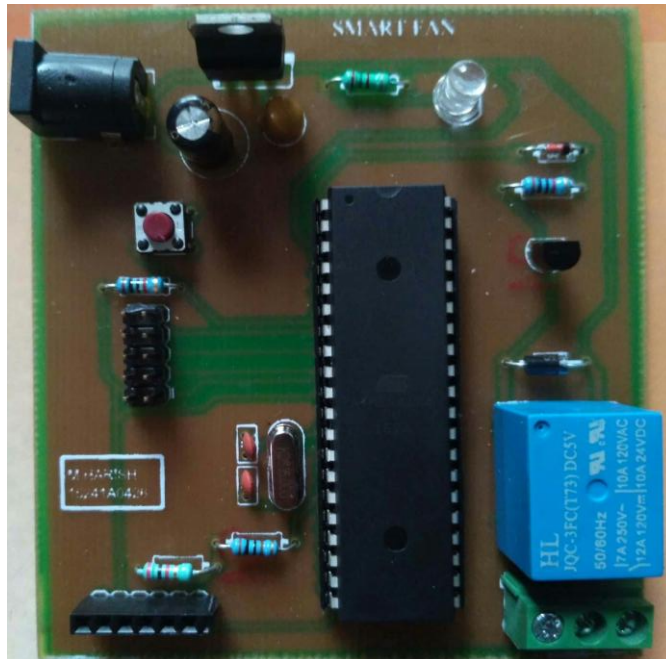
- 12 Volt DC Fan

Software:

- Android Application

4. THEORY

- ## *ATMega16:*

  ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing, Know more about RISC and CISC Architecture) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz. ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively. ATmega16 is a 40 pin microcontroller.

- ## *7805 IC:*

  A Regulated Power supply is very much essential for several electronic devices due to the semiconductor material employed in them have a fixed rate of current as well as voltage. The device may get damaged if there is any deviation from the fixed rate.
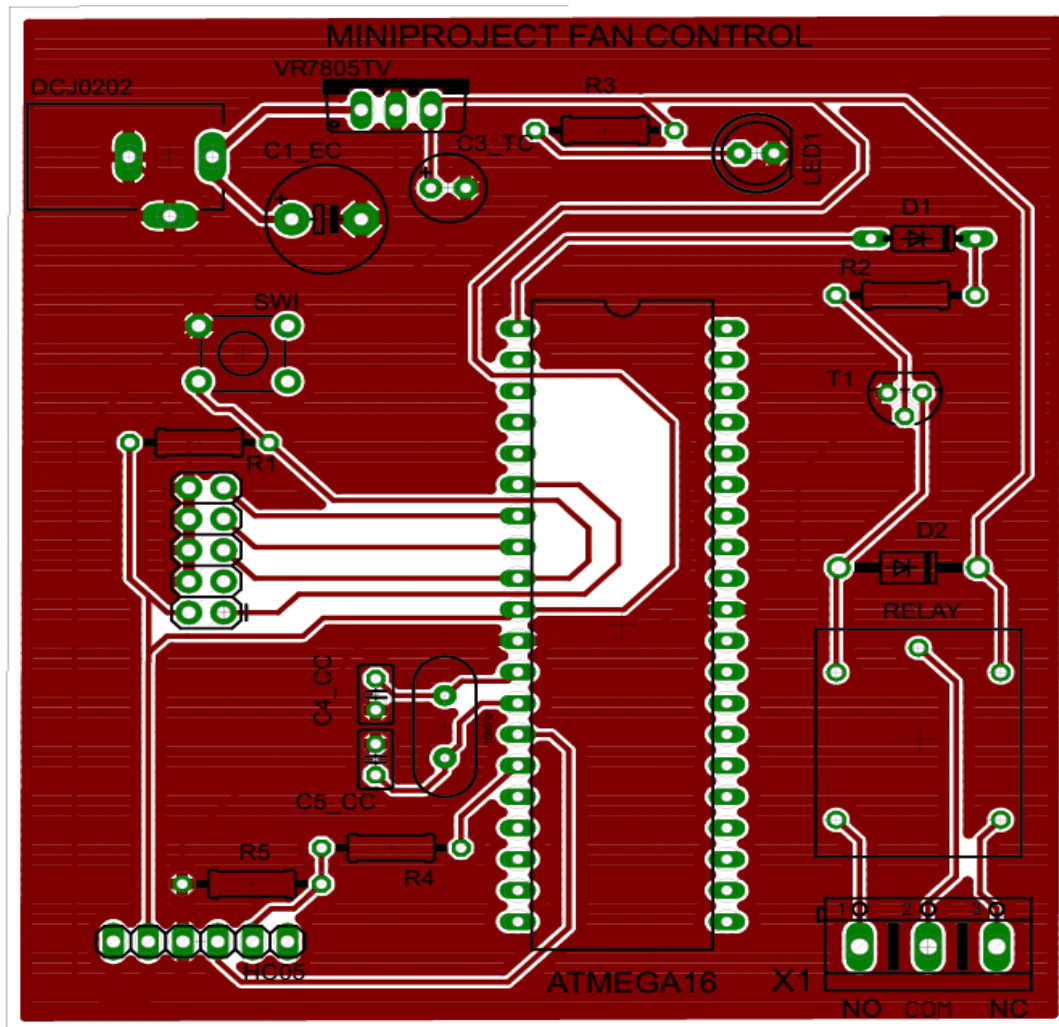
- ## *HC-05 Module:*

  HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).
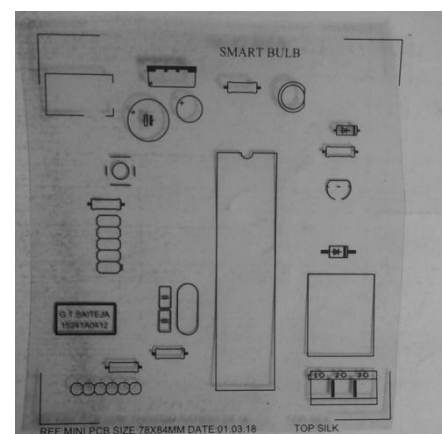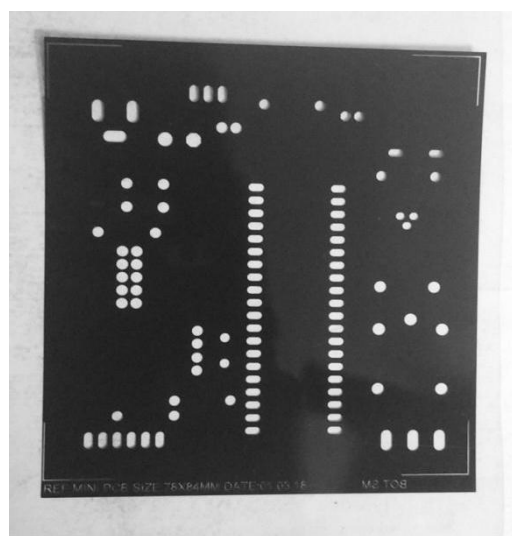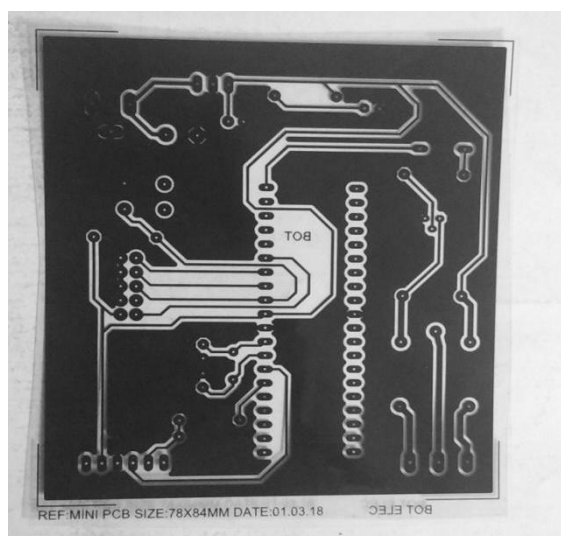
- ## *RELAY:*

  *A **relay** is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit.Relays were used extensively in telephone exchanges and early computers to perform logical operations.*

5. SCHEMATIC

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6. BOARD DESIGN

- ## GERBER FILES

7. PROJECT CODE

AVR PROGRAMMING (EMBEDDED C):

```c
#include <avr/io.h>            //include all the ATMEGA16 input-output files
#define BAUDRATE 9600              //Transmission baud rate
void usart_init(void);        //declare a USART initialization function
char usart_rx(void);             //declare a USART receive function
char rx_data;                 //declare a character variable to store RX data


int main(void)                    //main-program execution starts here
{
     usart_init();                //Initialize the USART function
     DDRB=0xFF;                     //defining PORT B as output
  while (1)                        //Infinite loop
  {
     rx_data=usart_rx();             //getting received data into "rx_data"
        if(rx_data=='1')         //checking the condition
        {
           PORTB=0xFF;              //making all PORTB pins as high
        }
        else if(rx_data=='2')     //checking the condition
        {
           PORTB=0x00;              //making all PORTB pins as low
        }


  }
}


void usart_init()               // defining the USART initialization function
{
UBRRH=0x00;                         //give corresponding Higher 8 bits to UBBRH register
```
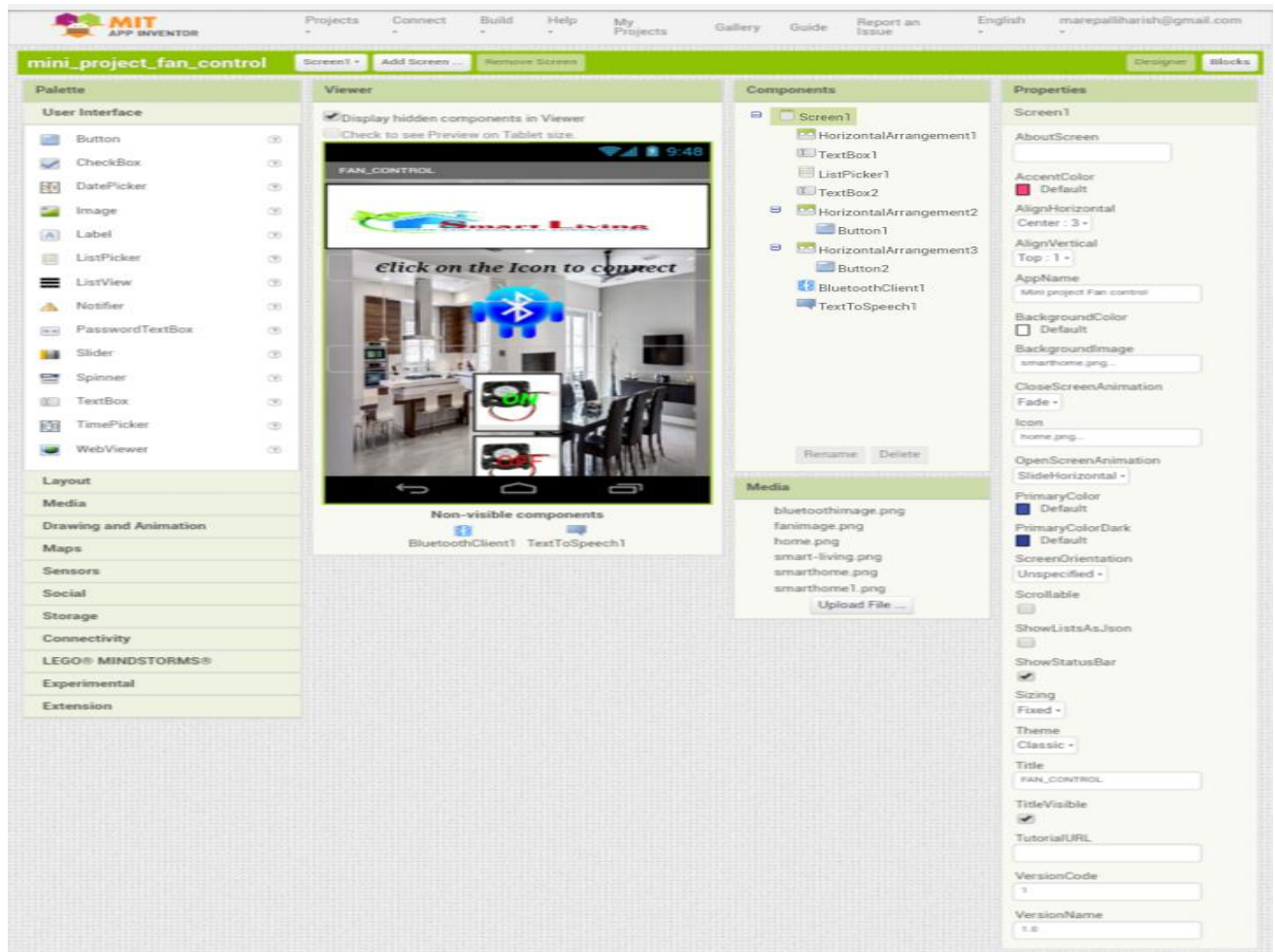
```c
    UBRRL=0x67;                              //give corresponding Lower 8 bits to UBBRL register

    UCSRB= (1<<TXEN) | (1<<RXEN);            //enabling transmit and receive bits

    UCSRC= (1<<URSEL) | (3<<UCSZ0);          //assigning 8 bit character size

}

char usart_rx(void)                          // defining the USART receive function

{

    while(!(UCSRA & (1<<RXC)));              //check whether receive is complete

     return UDR;                             //return data from UDR

}
```
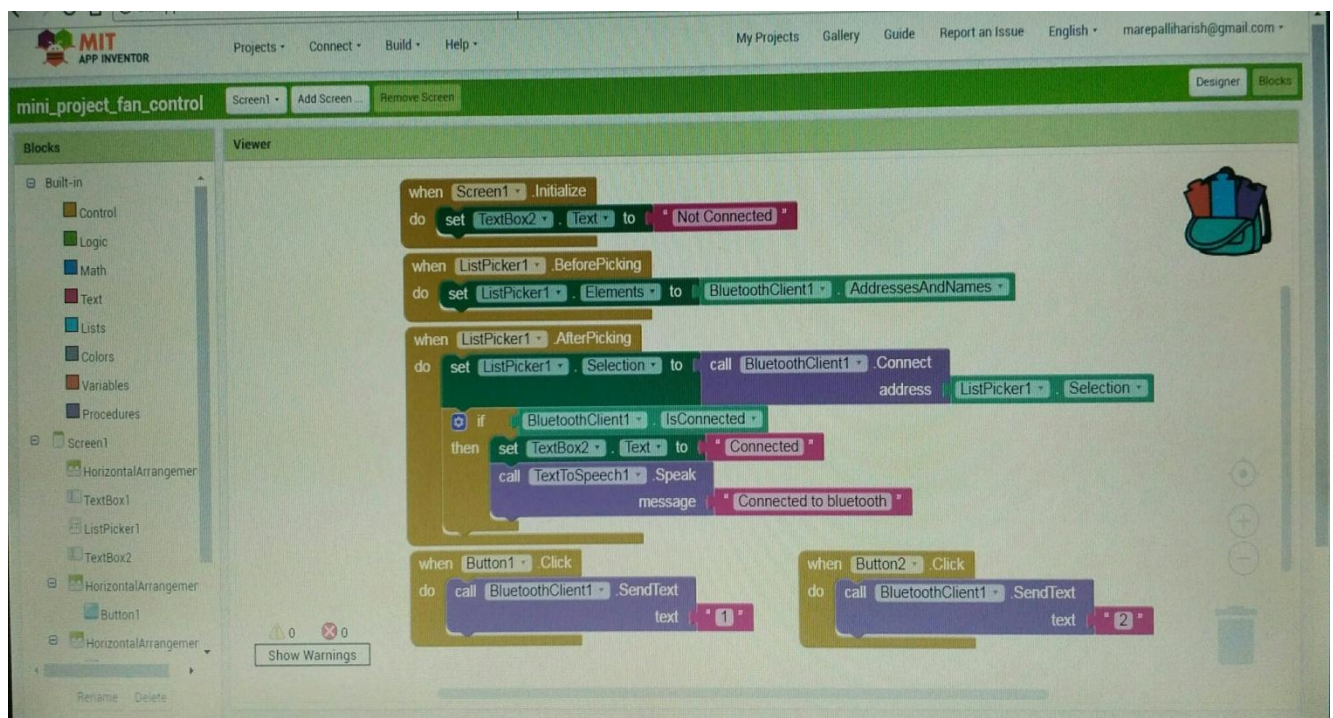
8. ANDROID APP DESIGN

- *Designer Window:*

- *Blocks Window:*

9. CONCLUSION

- *The project "HC-05 Bluetooth and Relay based Android Mobile Controlled 12 Volt DC Fan With ATmega16" has been successfully designed and tested. It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit.*

- *The Wireless-networking standard technology such as Bluetooth has quietly became a common way to replace the wires on short distances. With a gadget such as a smart phone (Android Phone) or a tablet featured with a Bluetooth module, a wireless connection is the easiest way to Send and receive information. And because this technology spread in the prototyping culture, it's often used to control things wirelessly.*

- *Finally I conclude that "Home automation" is an emerging field and there is a huge scope for research and development. The Printed circuit board is designed such that the microcontroller embedded into it can be reprogrammed with some ease.*

10. REFERENCES

- http://www.ablab.in/relay-and-hc-05-bluetooth-based-android-mobile-controlled-wireless-home-automation-system-with-avr-atmega16-microcontroller/

- https://circuitdigest.com/

- http://extremeelectronics.co.in/avr-tutorials/using-the-usart-of-avr-microcontrollers-reading-and-writing-data/

- http://www.avrfreaks.net/forum/uart-serial-communication

- http://www.electroschematics.com/9431/flash-burning-process-program-explanation/

- http://www.engbedded.com/fusecalc

- http://appinventor.mit.edu/explore/#