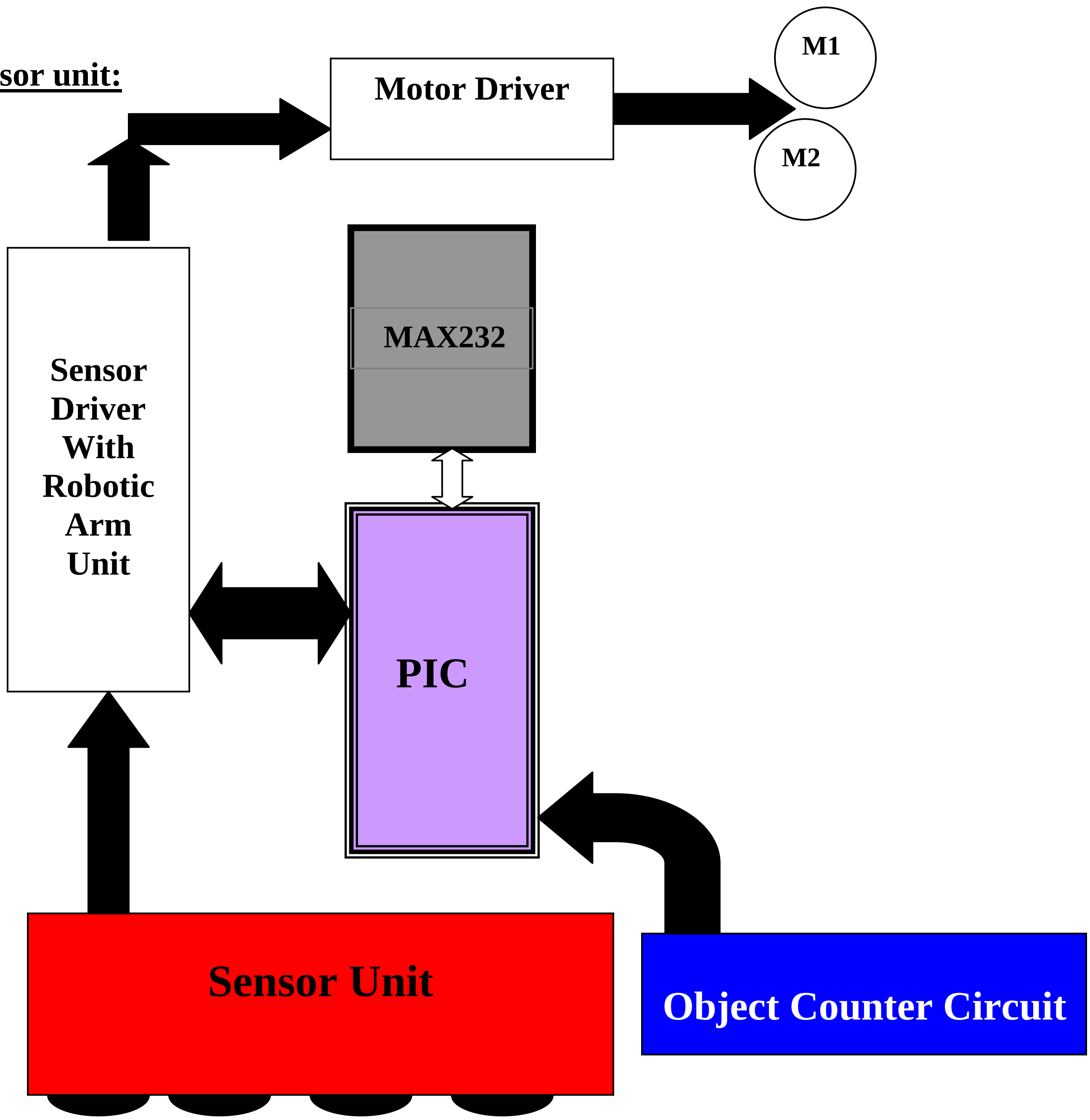
Wireless Voice color Sensing Robot

Aim: This Robot will count and Sense the cloth through voice with color for Textile for owner.

<u>Sensor unit:</u>



Description:

This Monitoring and Control system having three different modules,

1) Sensor Unit
2) Voice Processing Unit
3) Wireless Robot

1) Sensor Unit

   This is divided into different modules,

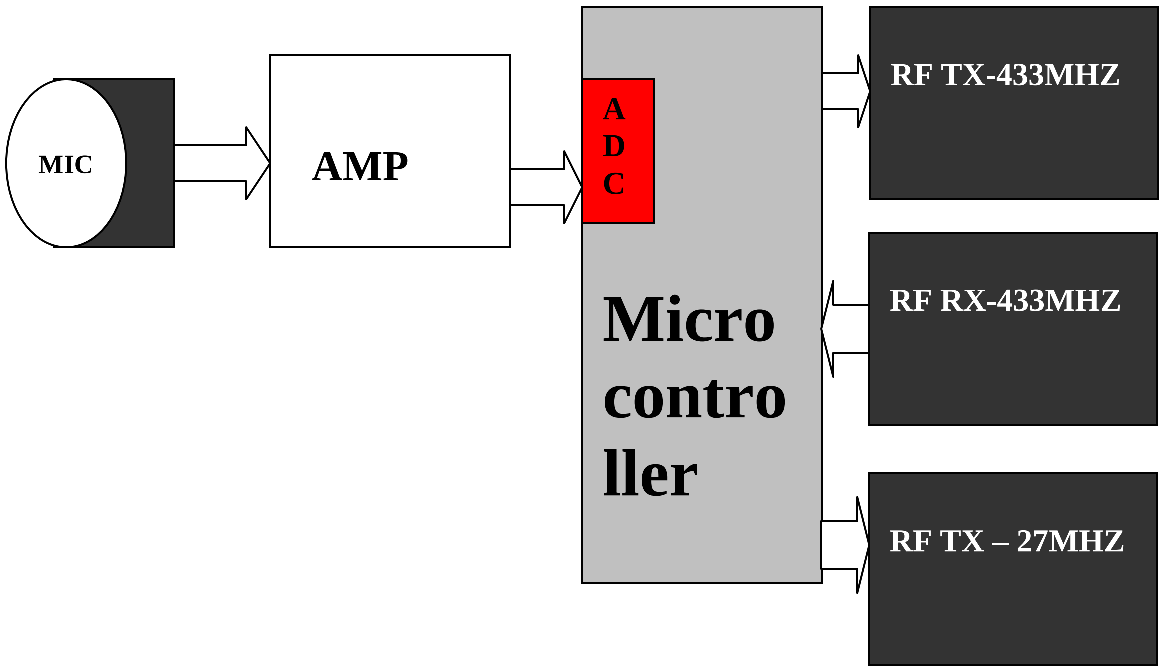
   a) Sensor Pattern design

2) Voice Processing Unit

   This is divided into three modules,

   a) RS232 communication,
   b) Color LED Display module
   c) Embedded DSP

Block Diagram of Voice Sensing and Processing Unit:



- ***Rationale and sources of your project idea*:**

A high tech robotic car responding to vocal commands and driving according to human speech. A car move using speech recognition. The required computation to process speech would normally overflow the AT89C51 memory.

Background math:

Speech Analysis:
In order to analyze speech, we needed to look at the frequency content of the detected word. To do this we used several 4^{th} order Chebyshev band pass filters. To create 4^{th} order filters, we cascaded two second order filters using the following "Direct Form II Transposed" implementation of a difference equations.

Where the coefficient a's and b's were obtained through Matlab using the following commands.

[B,A] = cheby2(2,40,[Freq1, Freq2]);

(Where 2 defines a 4^{th} order filter, 40 defines the stop band ripple in decibels, and Freq1 and Freq2 are the normalized cutoff frequencies).

[sos2, g2] = tf2sos (B2, A2,'up','inf');

Fingerprint Calculation:
Due to the limited memory space on the Mega32, we needed a way to encode the relevant information of the spoken word. The relevant information for each word was encoded in a “fingerprint”. To compare fingerprints we used the Euclidean distance formula between sampled word fingerprint and the stored fingerprints to find correct word.

Where P is a dictionary fingerprint and Q is the sampled word fingerprint and p i and q i are the data points that make up the fingerprint. To see if two words are the same we compute the Euclidean distance between them and the words with the minimum distance are considered to be the same. The formula above requires squaring the difference between the two points, but since we are using fixed point arithmetic, we found that squaring the difference produced too large of a number causing our variables to overflow. Thus we implemented a "pseudo Euclidean distance calculation" by moving the sum out of the square root reducing the equation to

PWM duty cycle calculation:
The motors in the car were measured to have a 50 Hz PWM frequency and movement was controlled by varying the duty cycle from 5% to 10%. To generate the PWM signals we used timer/counter1 in phase correct mode. The top value of timer/counter 1 was set to be 20000 and using a /8 prescalar the PWM signal was set to have a frequency of 50Hz = 16MHz/(8*2*20000). To calculate the duty cycle the following equation was used OCR1x = (20000 - 40000*duty cycle). Where OCR1x is the value in the output compare register 1 A or B.

- ## ***Hardware/Software tradeoffs*:**

The signal coming out of the microphone needed to be amplified. We had two different versions of operational amplifier, LMC 711 and LM 358. The LMC711 has a slew rate of 0.015 V/µs, on the other hand LM 358 has 0.3V/µs. The LM358 has a better slew rate and it gave us better response to input signal, so we used it when we designed our amplification circuit.

The signal processing of speech requires lot of computations, which implies we need fast processor, but we had to operate at 16 MHz. In order to minimize the number of cycles we used filtering the audio signal we had to write most of the code in assembly. We wrote all of 10 digital filters in assembly which made them very efficient and significantly improved our performance over a C code implementation.

Software/Hardware Design

1) Software Description

Overview:

The Basic algorithm of code is to check the ADC input at a rate of 4 KHz. If the value of the ADC is greater than the threshold value it is interpreted as the beginning of a half a second long word. The sample word passes through 8 band pass filters and is converted into a fingerprint. The words to be matched are stored as fingerprints in a dictionary so that sampled word fingerprints can be compared against them later. Once a fingerprint is generated from a sample word it is compared against the dictionary fingerprints and using the modified Euclidean distance calculation finds the fingerprint in the dictionary that is the closest match. Based on the word that matched the best the program sends a PWM signal to the car to perform basic operations like left, right, go, stop, or reverse.

Software Requirements:

1) Embedded C : KeilC51, AVR -Codevision
2) C51, AVR
3) Windows

Hardware Requirements:

1) AT89C51
2) ATMEGA32
3) Max232

Advantage of these Systems:

1) Automation of all Textiles to communicate through remote Voice
2) Save data using automatic control systems
3) Less cost to communicate
4) Less power to automate
5) Increase productivity
6) To increase n number of customer to communicate and automate.
7) Easy and fast production of the system

Feature of these system:

1) To automate all customer to communicate through mobile via SMS Communication.
   To modify this system into Police for Security System.