Chapter – 3

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89S52 MICROCONTROLLER BASED SPEED CONTROL OF VEHICLES NEARBY EDUCATIONAL INSTITUTIONS

This work was chosen to design an Embedded system with 8 bit microcontroller, it is to implement the earlier embedded system using microcontroller 89S52, the application was developed using RF transceiver modules. The circuit was carefully designed to interface the RF transceiver. Application was so chosen to reduce the road fatalities, specifically the school children vulnerably affected by the speed of the vehicle. In this work, the suitable ALP (Assembly Language Program) has been written. Both the hardware module and software were tested for their functionalities. From this work, one who easily knows that the need of hardware and much software for implementing the system. The resources available in 89S52 [1] microcontroller are limited and need of more instructions. At the end, the functional difference of 8085 microprocessor and 8 bit microcontroller are tabulated.

3.1. INTRODUCTION

In the modern world, one of the worst scenarios is road fatalities. Road fatalities are a major concern in human life. Recent studies [2] show that a third of the number of fatal or serious accidents is associated with excessive or inappropriate speed of the vehicles, as well as changes in the road way (like the presence of road work or unexpected obstacles). Reduction of the number of accidents and mitigation of their consequences are big concern of traffic authorities, the automotive industry and transport research groups. Advanced driver assistance system is the solution,
which are acoustic or visual signals produced by the vehicle itself to communicate the
driver about the possibility of the accident. These advanced systems are somewhat
available in almost all commercial vehicles today, and future trends indicate that the
higher safety will be achieved by automatic driving signals and a growing number of
sensors both on the road, at accident prone zones and inside of the vehicle [3].

Pedestrians especially school children are the most vulnerable traffic
participants, because they are often seriously injured in traffic accidents. Pedestrian
signal detection is to alert the driver and for automatic speed control in such areas.
Generally, to assist the vehicle driver, Cruise Control (CC) may be used, which has
the capability of maintaining a constant user preset speed[4], and its evolution is
Adaptive Cruise Control (ACC), which adds to cruise control with the capability of
keeping safe distance from preceding vehicle[5]. A drawback of these systems is that
they are not independently capable of distinguishing between straight and curved
parts of the road, where the speed has to be lowered to avoid accidents. However,
Curve Warning Systems (CWS) have been recently developed that use a combination
of Global Positioning System (GPS) and digital maps obtained from a Geographical
Information System (GIS), to assess threat levels for a driver approaching a curve too
quickly [6]; likewise Intelligent Speed Assistance (ISA) systems warn the driver when
the vehicle’s velocity is inappropriate, using GPS in combination with a digital road
map containing information about the speed limits [7]. However, useful of these
systems are inoperative where unusual road circumstances such as road work, road
diversions, accidents etc. RF modules [8] not only used at educational institutions,
may also be placed any places where the necessity exist to warn the driver. While
artificial vision based recognition of traffic signals might fail if visibility is poor,
insufficient light, difficult weather conditions or blocking of the line of sight by
preceding vehicles, RF signals might still be transmitted reliable. This work is to focus mainly the application of 89S52 controller. Radio frequency (RF) is a rate of oscillation in the range of about 30 kHz to 300 GHz, which corresponds to the frequency of electrical signals normally used to produce and detect radio waves. RF sensor module is reliable with its high distance coverage and cost effective. Similar kind of work has done by Joshue Perez, where they used RFID tags for the application to control the speed of the vehicle [9].

The following sections presents functional description of 433 MHz RF transmitter STT-433, and 433 MHz RF receiver STR-433 [10], HT 12E Encoder, HT12D Decoder, [11] and the features of 89S52 microcontroller. Also the functional description of the circuit diagram and ends with the conclusion. The Figure 3.1 illustrates block diagram of the transmitter module placed in the pedestrian signal nearby the educational institution.

![Figure 3.1: Transmitter Module](image)

The Figure 3.2 is the block diagram to illustrate the receiver module, placed in the vehicle to be controlled.

![Figure 3.2: Receiver Module](image)
3.2. COMPONENTS DISCUSSION

This section describes the sensors, decoder, encoder, and the features of microcontroller 89S52, which had been installed at the pedestrian signal before the Educational Institution or any other places of accidental prone zones, where the need of automatic speed control.

3.2.1. 433 MHz RF Transmitter STT-433

It is low cost RF transmitter [8], and operates from 1.5 to 12V supply. The transmitter employs a SAW- stabilized oscillator, ensuring accurate frequency control for best range performance. Small in size consumes 11mA at 3V. Its minimum data rate 200 BPS and maximum is 3KBPS. It has good temperature adaptability (from -20°C to + 60°C).

OOK (on off keying) modulation is a binary form of amplitude modulation. When a logical 0 (Data line low) is being sent, the transmitter is off, fully suppressing the carrier. In this state, the transmitter current is very low, less than 1 mA. When a logical 1 is being sent, the carrier is fully on. In this state, the module current consumption is at its highest, about 11 mA with a 3V power supply. OOK is the modulation method needs no power when it transmits a 0, and requires better power consumption than FSK transmitters for transmitting 1. OOK data rate is limited by the start up time of the oscillator. High Q oscillators which have very stable center frequency take longer to startup than low Q oscillators. The startup time of the oscillator determines the maximum data rate that the transmitter can send. Data rate could be controlled by the oscillator startup time. It is on the order of 40 μs, which limits the maximum data rate to 4.8 kbit/sec. In the transmitter SAW stabilized
oscillator is used, basically the transmitter is a negative resistance LC oscillator, whose center frequency is tightly controlled by a SAW resonator. SAW (Surface Acoustic Wave) resonators are fundamental frequency devices that resonate at frequencies much higher than the crystals.

3.2.2. 433 MHz RF Receiver STR-433

The receiver module requires no external RF components except for the antenna. It generates virtually no emission. It is low cost, operating voltage is 5V and the operating current is typically 3.5 mA and requires no external parts. Receiver frequency is about 433.92 MHz, whose sensitivity is -105dBm. Data rate of the receiver is 3 K bits/s.

The STR – 433 [8] uses a super - regenerative AM detector to demodulate the incoming AM carrier. A super regenerative detector is a gain stage with positive feedback greater than unity so that it oscillates. An RC time constant is included in the gain stage so that when the gain stage oscillates, the gain will be lowered over time proportional to the RC time constant until the oscillation eventually dies. When the oscillation dies, the current draw of the gain stage decreases, charging the RC circuit, increasing the gain, and ultimately the oscillation starts again. In this way, the oscillation of the gain stage is turned on and off at a rate set by the RC time constant. This rate is chosen to be super audible but much lower than the main oscillation rate. Detection is accomplished by measuring the emitter current of the gain stage. Any RF input signal at the frequency of the main oscillation will aid the main oscillation in restarting. If the amplitude of the RF input increases, the main oscillation will stay on for a longer period of the time, and the emitter current will be higher. Therefore, we
can detect the original base-band signal by simply low pass filtering the emitter current. The average emitter current is not very linear as a function of the RF input level. It exhibits a $1/\ln$ response because of the exponentially rising nature of oscillator start-up. The steep slope of algorithm near zero results in high sensitivity to small input signals.

Another important block in the receiver is Data slicer, which converts the base band analog signal from the super-regenerative detector to a CMOS/TTL compatible output. Because the data slicer is AC coupled to the audio output, there is a minimum data rate. AC coupling also limits the minimum and maximum pulse width. Typically data is encoded on the transmit side using pulse width modulation (PWM) or non return to zero (NRZ). The most common source for NRZ data is from a UART embedded in a microcontroller. Applications that use NRZ data encoding typically involve microcontrollers. Data is sent as a constant rate square wave. The Duty cycle of that square wave will generally be either 33% (a zero) or 88% (a one). The data slicer on the STR-433 is optimized for use with PEM encoded data, though it will work with NRZ data if certain encoding rules are followed.

Power supply is another important factor to work with any passive components. The STR-433 is designed to operate from a 5V power supply. It is crucial that this power supply be very quiet. The power supply should be bypassed using 0.1\mu F low-ESR ceramic capacitor and a 4.7 \mu F tantalum capacitor. These capacitor should be placed as close to the power pins as possible. The STR-433 is designed for continuous duty operation. From the time power is applied, it can take up to 750 ms for the data output become valid.
STR-433 support most antenna type, including printed antennas integrated directly on to the PCB and simple single core wire of about 17cm. the performance of the different antennas varies. Any time a trace is longer than $\frac{1}{8}$th the wave length of the frequency it is carrying, it should be a 50 ohm microchip.

### 3.2.3. HT-12E Encoder

HT-12E is the encoder [9] capable of encoding information which consists of N address bits and 12- N data bits. Each address/ data input can be set to one of the two logic states. The programmed addresses/data are transmitted together with the header bits via RF or an infrared transmission medium upon receipt of a trigger signal. Its operating voltage is 2.4V - 12V. It is fabricated using CMOS technology, housed in 18 pin DIP. Other features are listed as follows:

- Low standby current: $0.1 \mu$A at $V_{DD} = 5V$
- Minimum transmission is four words
- Built in oscillator needs only 5% resistor
- Data code has positive polarity
- Minimal external components.

The status of each address / data pin can be individually pre-set to logic “high” or “low”. If a transmission- enable signal is applied, the encoder scans and transmits the status of the 12 bits of address/data serially in the order A0 to A11. During information transmission these bits are transmitted with a preceding synchronization bit. If the trigger signal is not applied, the chip enters the standby mode and consumes a reduced current of less than $1 \mu$A for a supply voltage of 5V.
3.2.4. HT-12D Decoder

HT-12D decoders [9] receive serial addresses and data programmed series of encoders that are transmitted by a carrier using RF or an IR transmission medium. They compare the serial input data three times continuously with their local addresses, if no error or unmatched codes are found, the input data codes are decoded and then transferred to the output pins. The VT pin indicates the status of transmission, when it is high means, it is valid transmission. This decoder is capable of decoding information that consists of N bits of address and 12-N bits of data. For proper operation a pair of encoder/decoder with the same number of addresses and data format should be chosen.

3.3. FEATURES OF 89S52 MICROCONTROLLER

The AT89S52 microcontroller [1] is a low power, high performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable flash memory. The specialty over its predecessor is on-chip Flash memory which allows the program memory to be reprogrammed in-system. This controller consists of 8-kbytes of Flash, 256 bytes of RAM, 32 I/O lines, watchdog timer, two data pointers, three 16-bit timer/counters, a six vector two level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. The AT89S52 has three ports which are having multiplexed functions.

3.4. FUNCTIONAL DESCRIPTION OF THE CIRCUIT

The AT89S52 microcontroller has programmed to transmit the 4-bit data through the port signals P2.0 - P2.3, which are connected with data lines of HT12-E encoder. These data lines are known as the unique address of Institutions, where
speed to be lowered. In this work, the encoder address lines are normally tied with logic 0 as it is a single module placed in the road of particular institution. The encoder then, transmits this information through $D_{out}$ pin serially to the RF transmitter with appropriate synchronization bit. Upon receiving this information RF transmitter, transmit this information over the space. The typical foot coverage of the transmitter is 400 foot for the outdoor and 200 foot for the indoor. However, this module is used in the outdoor only. The Figure 3.3(a) shows the transmitter module placed in the pedestrian signal nearby the educational institution.

Figure 3.3(a): Transmitter Module
Figure 3.3(b) shows the schematic diagram of Transmitter module.

In the receiver side, the antenna output is connected to the input pin of STR-433, which demodulate the incoming AM carrier, then outputted to decoder HT-12 D, where the serial information about the zone is converted back to the 4-bit data. This data will be accessed by the microcontroller through the port signals P2.0-P2.3 and then pulse width modulated (PWM); according to the zonal information the speed of the vehicle will be controlled. In this work a DC motor used
in the laboratory to reduce the speed. The Figure 3.4(a) shows the schematic diagram of the receiver module and the Figure 3.4(b) shows receiver module with toy car, to be placed in the vehicle, developed in the laboratory for demonstration.

Figure 3.4(a): Receiver module schematic diagram

Figure 3.4(b): Receiver module developed in the laboratory
3.5. CONCLUSION

This work is based on 89S52 microcontroller with RF sensor to control the speed control of the vehicle at the Educational institution, which can help to decrease one of the major cause of fatalities due to the excessive vehicle speed. Aim of this work was developed based on the application of microcontroller and RF modules. However practically, there is a need of speed measurement devices and controlling devices. Speed can be measured from the speedometer, but precision is limited to four pulses for one turn of the vehicle’s wheels, which gives insufficient resolution at low speeds.

In order to obtain the high precision speed measurement differential Hall effect sensor could be used, which gives not only high precision and whose output easily processed by converting analog to digital form. To lower the speed, the throttle automation is required. The throttle can be controlled with an analogue signal generated with the automation circuit. Similarly automatic breaking system is required when automation system is failed. Although the experiments reveals that effective speed control, much more required for effective speed control system to meet the challenges exist in various situations.

Thus the aim of the work is the effective utilization of 8 bit microcontroller 89S52 for the Embedded System. This automatic speed control system is an example for Embedded system with 89S52 microcontroller as a processor / Controlling device. Here are the difference between the 8 bit microprocessor (Eg. 8085) and 8 bit microcontroller (Eg. 89S52).
Difference between the Microprocessor and Microcontroller

A microprocessor and a microcontroller are both essentially processors that are designed to run computers. The type of the computer machinery that the two run is different, though essentially the main task of both the microprocessor and the microcontroller is the same. Both are generally termed as the core of any machinery that has a computerized form. One is a specialized form of processor whereas the other is found in all computers.

Microprocessors

Microprocessors are normally called what we refer to as a Central Processing Unit, also commonly known as the heart and the brain of any computing machine. A microprocessor is required to perform an array of tasks. These are of general purpose and therefore it is said that the microprocessor is essential to perform the logical operations. The microprocessors are configured into microchips to serve their purpose of start a computer and boot commands as and when the computer is prompted to do so.

Microcontrollers

Microcontrollers are specific in nature to the task they need to perform. Usually found present in automobiles and appliances, the microcontroller has a microprocessor on its board to carry out all the logical operations of the gadget. The microcontroller once programmed, can work on its own since it has a stored set of instructions that it executes as and when required. A microcontroller can be easily said to be a small microprocessor that has a CPU, RAM, ROM and the input and output ports all embedded on the single microchip.
Table 3.1 presents the similarities and dissimilarities of 8085 and 89S52.

**Table 3.1: Similarities and dissimilarities of 8085 and 89S52**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Function/ Features</th>
<th>Intel 8085</th>
<th>Atmel 89S52</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Bit Length</td>
<td>8 Bit</td>
<td>8 Bit</td>
</tr>
<tr>
<td>2.</td>
<td>Inbuilt RAM</td>
<td>NA</td>
<td>256 Byte</td>
</tr>
<tr>
<td>3.</td>
<td>Inbuilt ROM</td>
<td>NA</td>
<td>8KB ROM</td>
</tr>
<tr>
<td>4.</td>
<td>Flash Memory</td>
<td>NA</td>
<td>8 KB</td>
</tr>
<tr>
<td>3.</td>
<td>Serial ports</td>
<td>External</td>
<td>Internal Full duplex Serial port</td>
</tr>
<tr>
<td>4.</td>
<td>Parallel ports</td>
<td>External</td>
<td>Three 8-Bit Ports available</td>
</tr>
<tr>
<td>5.</td>
<td>Timer</td>
<td>NA</td>
<td>3 16 bit Timers + Watch dog timer (13 Bit)</td>
</tr>
<tr>
<td>6.</td>
<td>Addressing capacity</td>
<td>64 KB</td>
<td>64KB</td>
</tr>
</tbody>
</table>

**Comparison of Microprocessor and Microcontroller**

The major difference between a microprocessor and a microcontroller are their functions. Where a microprocessor has more generalized functions, a microcontroller is more specific to its task and it is more suitable for designing Embedded system.

A microprocessor may not also be programmed to handle real-time tasks whereas a microcontroller such as in devices that need to control temperature of water or perhaps measure the temperature of a room require real time monitoring and therefore with its inbuilt set of instructions the microcontroller works on its own.

A microprocessor requires constant input by a human such as in a personal computer so that instructions can be boot. A microprocessor is the memory of the computing machine whereas the microcontroller integrates the entire computer in a single chip. Not only does it have the memory embedded in, it also has input and output ports plus peripherals such as timers and converters. All this can be handled with a single touch.
Both microprocessors and microcontrollers have to run commands and therefore run a device on its own, however it’s the minute architectural design of the microcontroller that leaves a person interested in awe of the tasks it can perform when it is compared to a microprocessor. When a person requires running a word document or a video game on their computers they are essentially using the microprocessor, and when they have to work a microwave oven, they are working a microcontroller. Therefore, microcontrollers are more specific to the appliance they are configured for.
REFERENCES

1. Datasheet of AT89S52 microcontroller, web site http://www.atmel.com
11. Data Sheet of HT-12E Encoder and HT-12D Decoder: Holtek Semiconductor Inc.