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RF BASED NAVIGATION SYSTEM FOR INTER-DEPARTMENT TRANSPORTATION

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ABSTRACT

In an industry to maintain the stock receiving from vendors is very difficult and time consuming process. To overcome this problem we use wireless automated system that will be more useful in not only maintaining the stocks but also move the material from one block to another using RF based navigation system An attempt to design and develop a wireless navigation system for industry using ARM 7processor, for reducing the time and effective moment of the stock is implemented. The reduction in the time of 30 min is to be achieved for the most.

KEYWORDS: ARM-7, RF-Trans-Receiver, Coding Scheme Algorithm

INTRODUCTION

In an industry to maintain the stock receiving from vendors is very difficult and time consuming process. To overcome this problem, use of RF based navigation system will be more useful in not only maintaining the stocks but also to move the material from one block to another using RF solution. Few years back the use of wireless device was very less, but due to the rapid development in technology, we can use wireless devices with maximum bit rate of 8bps. The fundamental aim of this work is to develop a RF based navigation system for industry using ARM7 processor. The system contains two parts, one is transmitter node and another one is receiver node. The transmitter node output is in encoded form and the receiver node output is in decoded form. In this work we deal with navigating a model of car using decoded output at receiver which is interfaced with ARM7 processor. This system reduces effective time needed for moment of stock from one department to other.

LITERATURE SURVEY

After surveying it was confirmed that with use of RF based navigation system there is possibility of transmission error. To achieve error free communication coding scheme is also embedded to improve reliability.

IMPLEMENTATION

The basic need of this work is to design a system which will maintain the stock receiving from vendors & deliver the material at specific department decided by operator. The path for navigation can be taken statically and dynamically. In statistical path there is predefined path that system follows. In case of dynamic path the system follows navigated path controlled by IR sensors. In this work, dynamic path system is used. There are various type of navigation-First is using GPS and second is using RF sensor. The GPS works on Coordinate system (NMEA protocol). GPS gives the coordinate in terms of latitude and longitude. The accuracy in latitude and longitude depends upon resolution of GPS module. Normally this resolution is 1Km and above. So, when system moves up to 1Km and above then and then only the coordinate will change. As we are developing the system for inter departmental use, the station distances may be small the coordinate will change. As we are developing the system for inter departmental use, the station distances may be small, as such, use of GPS system may prove in-accurate. For small station distances use of RF sensor is an ideal solution. The RF sensor works on 433 MHz and above. It consist 4 pin one for power supply (2V-12V), second for data, third for ground and forth pin for antenna. This sensor has two parts one is transmitter and other is receiver. The modulation scheme used for transmission of data in RF sensor is Amplitude shift keying. So the RF navigation approach is preferred for this work

Encoding Scheme

Shannon's channel coding theorem implies strong coding behaviour for random codes. As the code block length increases, the decoding complexity increases exponentially. Whereas, Sequences of codes with sufficient structure can be easily decoded by Shannon's theorem. However, in 1993, an approach to error correction coding was introduced which was provided for very long code-words with only modest decoding complexity. These codes were termed as'Turbo codes' or 'Parallel concatenated codes'. Because the decoding complexity is relatively small for the dimension of the code, very long codes are possible. This coding is mostly used in wireless communication.

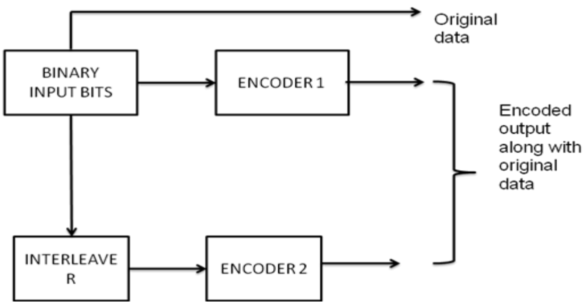

Figure 1: Block Diagram of Encoding Scheme

Encoding Process

Consider the input sequence = [1, 0, 1, 0, 1, 0, 1, 0] Then output of the first Encoder 1 is

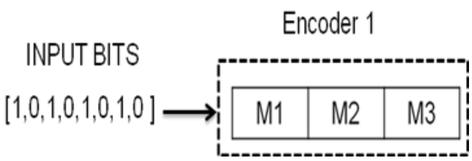

Figure 2: Block Diagram of Encoder 1

- Initially M1=0, M2=0 M3=0
- Then one bit from input is entered to the encoder and EX-OR operation is performed.
- M1, M2, and M3 bits are shifted and next bit from input entered at M1 and EX-OR operation is performed on M1 and M3 and this process repeats.

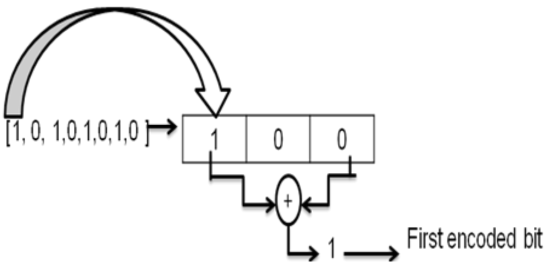

Figure 3: Encoding Process for Encoder 1

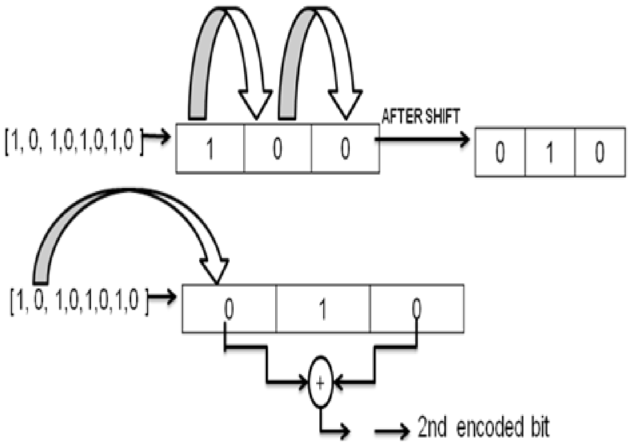

Figure 4: Shifting Operation for Encoder 1

- This process repeats finally we get output of Encoder1 as [1,0,0,0,0,0,0,0]

Similarly input bits (1, 0, 1, 0, 1, 0, 1, 0) are interleaved and applied to the Encoder 2. In the interleaver input data bits are arranged in row and column. Reading of data will be in row wise fashion. As such Interleaver output will be

[1, 0, 1, 0, 1, 0, 1, 0].

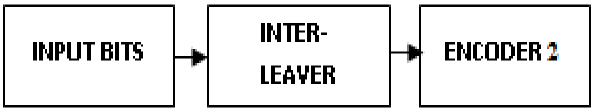

Figure 5: Block Diagram of Encoder 2

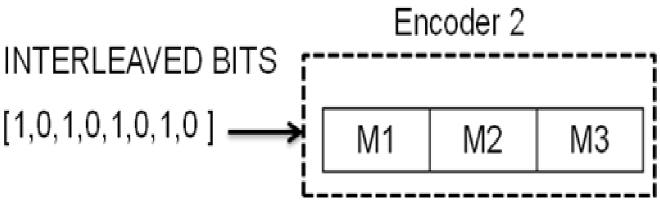

Figure 6: Block Diagram of Encoder 2

- Initially M1=0, M2=0 M3=0
- Then one bit from input is entered to the encoder and EX- OR operation is performed

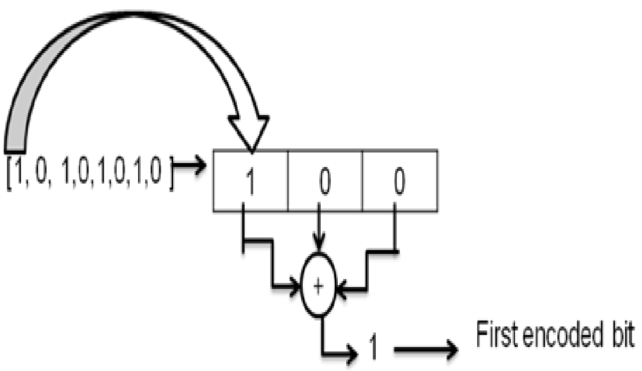

Figure 7: Encoding Process for Encoder 2

- M1, M2, and M3 bits are shifted and next bit from input entered at M1 and EX-OR operation is performed on M1, M2 and M3. This process repeats.

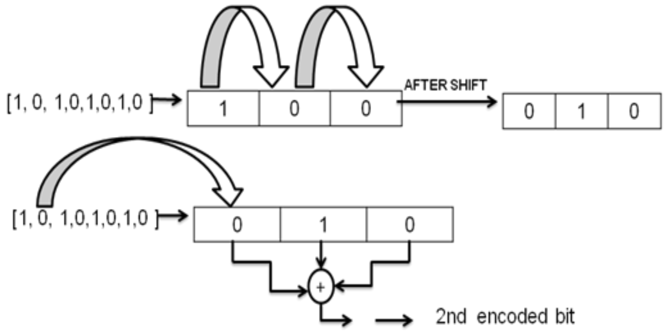

Figure 8: Shifting Operation for Encoder 2

- This process repeat and finally we get output of Encoder 2 as [1,1,0,1,0,1,0,1] then encoder transmits the output as shown in Table 1

Table 1: Encoder Transmitting Format

Encoder 1	Encoder 2	Original Input
1	1	1
0	1	0
0	0	1
0	1	0
0	0	1
0	1	0
0	0	1
0	1	0

Decoding Scheme (Sequential Algorithm)

In the decoding phase-1 at a time only one bit from original input bits is taken by decoder 1 which is treated as M1 and then EX-OR operation is performed on M1 and M3 bits. Then resultant output is compared with encoded bits from encoder 1. If it matches, then M1, M2 and M3 bits are shifted and goes to decoder phase 2. If it does not match then retransmission is initiated. In the decoding phase 2 at a time only one bit from original input bits is taken by decoder 1 which is treated as M1 and then EX-OR operation is performed on M1, M2 and M3 bits and then resultant output is compared with encoded bits from encoder 2. If it matches, then M1, M2 and M3 bits are shifted and goes to decoder phase 1. If it does not match then retransmission is initiated. These process repeats till all the bits are decoded.

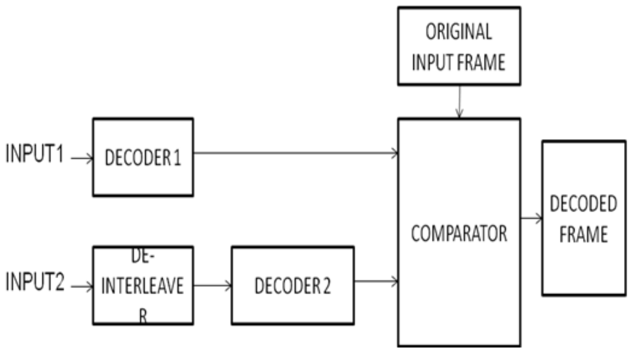

Figure 9: Block Diagram of Decoding Scheme

Consider following scenario

Encoded bits from encoder-1 → [1, 0, 0, 0, 0, 0, 0, 0]

Encoded bits from encoder-2 → [1, 1, 0, 1, 0, 1, 0, 1]

Original input bits→ [1,0,1,0,1,0,1,0]

- Initially M1=0, M2=0 M3=0
- Then one bit from original input frame is entered to the decoder and EXOR operation is performed

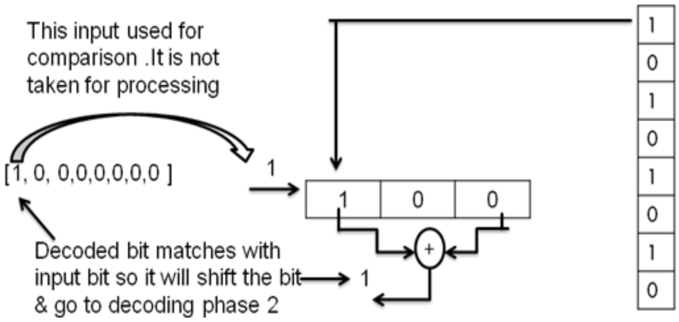

Figure 10: Decoding Process for Decoder 1

- If decoded bit matches with input bit then shifting operation is initiated and goes to decoding phase 2

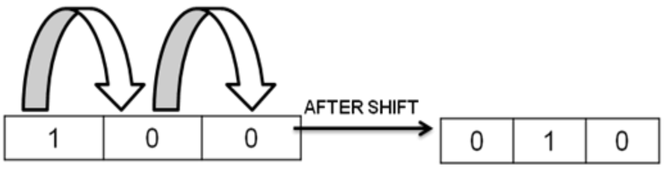

Figure 11: Shifting Operation for Decoder 1

- In decoding phase 2, again M1=0, M2=0 M3=0
- Then one bit from original input frame is entered to the decoder and EXOR operation is performed

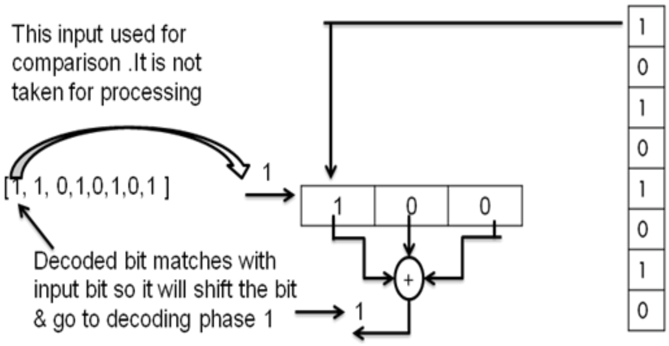

Figure 12: Decoding Process for Decoder 2

- If decoded bit matches with input bit then shifting operation is initiated and it goes to decoding phase 1 and so on. This process repeats until all bits are decoded. When encoder1 and encoder2 bits are decoded then and then only the original input comes out which is nothing but decoded frame. Finally we get decoded frame as [1,0,1,0,1,0,1,0].

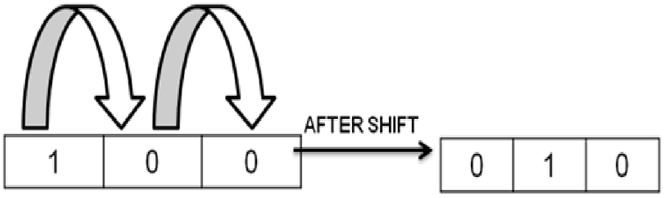

Figure 13: Shifting Operation for Decoder 2

From above example it is clear that soft output sequential algorithm has lower computational complexity. The sequential algorithm is not capable of error- recovery in the encoded bit stream. Soft decision decoding algorithm is the MAP algorithm, it is commonly called as the BCJR algorithm. It is capable of performing error recovery operation.

Error Recovery Algorithm

Consider following scenario →

Encoded bits from encoder-1 → [1,0,0,0,0,0,0,0] but we have consider that error is generated in the encoder1 output during transmission this is applied as input to decoder 1 i.e. [0,0,0,0,0,0,0,0]

Encoded bits from encoder-2 → [1,1,0,1,0,1,0,1] but we have consider that error is generated in the encoder2 output during transmission this is applied as input to decoder 2 i.e. [0,1,0,1,0,1,0,1]

Original input bits→ [1, 0, 1, 0, 1, 0, 1, 0]

- Initially M1=0, M2=0 M3=0

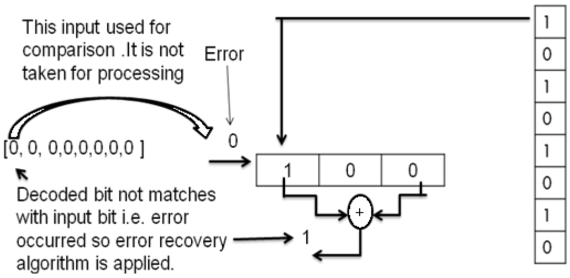

Figure 14: Process of Error Detection

- In error recovery algorithm again M1=0, M2=0 M3=0
- Then one bit from original input frame is entered to the decoder and EXOR operation is performed

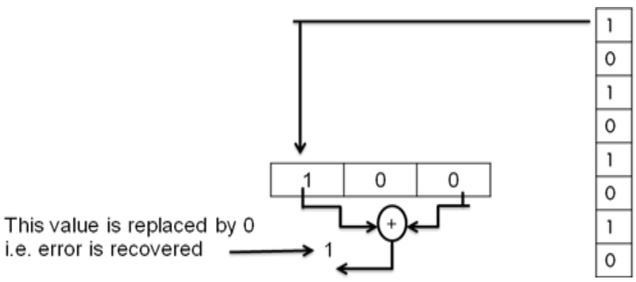

Figure 15: Process of Error Recovery

This process repeats till all errors in encoder bits are recovered. This scheme is implemented by means of software in proposed system.

PROPOSED SYSTEM

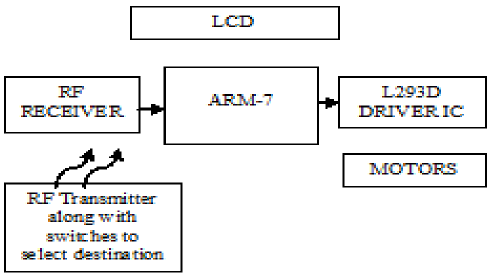

Figure 16: RF Based Navigation System for Inter-Department Transportation

In this work our main challenge is to design a model of car having embedded wireless sensor system which is useful for navigation of model car for transportation of raw material. In this system, when the 'key to select destination' is pressed, the destination information is transferred using RF transmitter. The output of RF transmitter is in coded form. This coded information is collected by RF receiver. The receiver will decode the information and used for car navigation. The controlling of car is done automatically by software and IR sensor attached to the controller.

For example, R&D department at Building1, Production department at building 2. Material movement is to be done from building 1 to building 2. First material is loaded on car at building 1. Then the respective button indicating destination as building no. 2 from keypad is pressed .This destination information is transferred via RF transmitter. RF receiver mounted on Car will collect this information & decodes it. Decoded information is given to ARM7 processor. The processor will process decoded information from RF receiver and gives the signal to driver circuitry. Driver circuit is a combination of relay and driver IC L293D. Car starts moving and navigated appropriately using IR sensor.

The basic principle of IR sensor is based on an IR emitter and an IR receiver. IR emitter will emit the infrared continuously when power is supplied to it. The IR receiver will be connected and perform the task of a voltage divider. IR receiver can be imagined as a transistor with its base current determined by the intensity of IR light received. The lower the intensity of IR light cause higher resistance between collector-emitter terminals of transistor, and limiting current from collector to emitter. This change of resistance will further change the voltage at the output of voltage divider. In others word, the greater the intensity of IR light hitting IR receiver, the lower the resistance of IR receiver and hence the output voltage of voltage divider will decreased.

Usually the IR emitter and IR receiver will be mounted side by side, pointing to a reflective surface. Based on this principle when model car starts moving on the path, IR sensor starts emitting light on a path, the IR ray reflected from the path is received by IR receiver mounted on the car .Output signal from IR receiver is given to ARM7 which in turn navigates the car. In this system to detect correct destination or departments (i.e. production, R&D,) a trans-receiver circuit using timer IC 555 (Astable mode as a transmitter) and TSOP 1738(receiver) circuit is designed.

Table 2: System Specifications

Title	Specification
1. Mode of Communication	Wireless
2. RF Trans-receiver	433 MHz
3. LCD	16×2 character LCD
4. Controller	ARM-7 (3V)
5. DC Motor	30-RPM
6. Sensor	IR SENSOR

RESULT TABLE

Table 3: Path Sensing Circuit

IR Sensor Output		Transistor Output (V)			
Without IR rays interruption	With IR rays interruption	Without IR rays interruption		With IR rays interruption	
		B-E O/P	C-E O/P	B-E O/P	C-E O/P
0.67	0.09	0.66	0.07	0.09	4.97

The timing diagram of proposed system is as shown in Figure 17 Waveform A-D shows encoding and decoding which is useful to navigate the system so that required destination is reached within less amount of time (less than 30 min) and waveform E indicates that destination transmitter transmits the IR rays continuously so that receiver can detect the required destination when receiver comes to the vicinity of destination transmitter. Waveform-F indicates that when appropriate destination is detected by destination receiver, destination receiver output goes low.

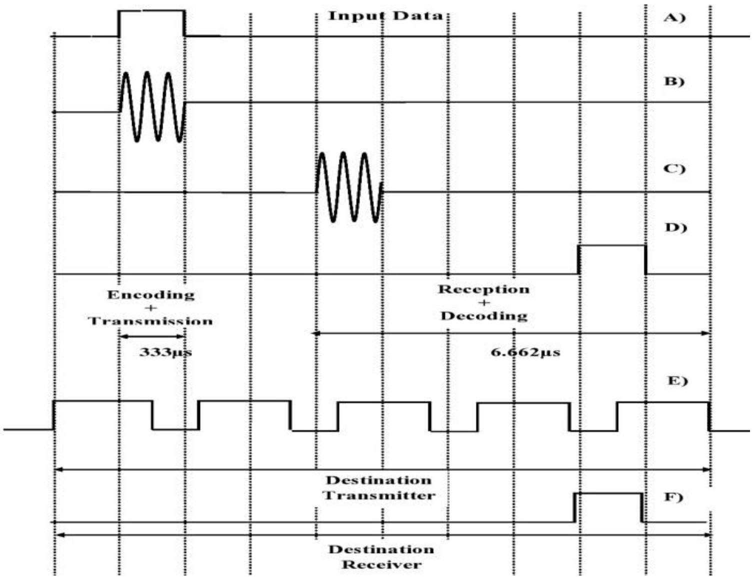

Figure 17: Timing Diagram of Proposed System

CONCLUSIONS

Thus from Table 4 it is conclude that the proposed system reduces the time by almost 30 min to maintain, & deliver the material at specific department decided by operator. This system has coding scheme implemented in it so that false navigation is avoided

Table 4: Comparison between Proposed and Available System

	RF Based Navigation	Guided Path Navigation
Navigation	Using IR Sensor	Using Predefined Path
Path storage	Not required	Path is stored in a system
Standard	ANSI/ITSDF B56.5-2005	Not required
Data security	Supports encoding and decoding so false navigation can be avoided	Not support so chances of false navigation
Error recovery	YES	NOT
Destination detection	339µs(Including encoding and Decoding)	500 µs
Modulation Scheme	Amplitude Shift Key(ASK)	NO concept of modulation

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