Home Security System with GSM Module using SPI,I2C and UART communication

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***Abstract*— This project aims to implement a simple and affordable, but efficient home security alarm system using SPI, I2C and UART communication. Along with this it also aims to differentiate between the different protocols of communication. The project is designed for detecting intruders and informing the owner by sending an SMS.**

Keywords— SPI communication, I2C communication SIM800l Module, Arduino Microcontroller, UART communication, IR sensor, GSM.

I. INTRODUCTION

A home security system provides peace of mind by alerting homeowners when there is a break-in or suspicious activity on their property. It also acts as a deterrent for potential burglars, as they are less likely to target homes with visible security systems.

Communication between different components is crucial for proper functioning of home security systems. Three common communication protocols used in these systems are SPI, UART, and I2C. These protocols are used to transmit data from sensors to the main control unit, which then processes the information and triggers alarms or alerts if necessary. Correct implementation of these protocols ensures reliable and efficient communication within the system, leading to better overall security.

II. BLOCK DIAGRAM

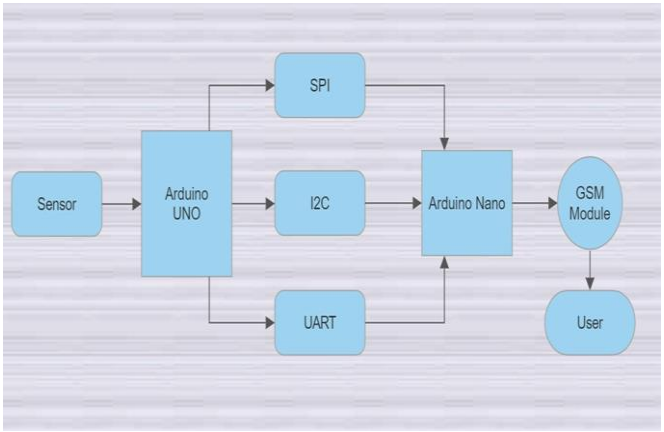

Fig 1. Block Diagram

III. METHODOLOGY

SPI communication:

SPI which stands for Serial Peripheral Interface is a synchronous communication protocol. It is a full-duplex protocol, allowing simultaneous data transfer between the Controller/Master device and the Peripheral/Slave device. It is only intended for short distance communications.

UART communication:

UART stands for Universal Asynchronous Receiver Transmitter. It is a Serial full duplex communication protocol. It requires two pins, Tx, which is used for transmission and Rx, which is used for receiving the data. Unlike SPI and I2C, it is one-on-one communication protocol.

I2C communication:

I2C, which stands for Inter Integrated Circuit, is a short distance communication protocol where data is transferred along a wire (SDA). To synchronize the devices connected, SCK pin is used. It allows multiple peripherals to be connected to a single controller/master device.

Approach:

The aim of the project is to alert the user about any intrusions using SPI, I2C and UART communication.

To achieve this, an IR sensor is used to detect the break in. The data thus gathered, is passed onto Arduino UNO allowing us to communicate using either SPI, I2C or UART protocol with connections as listed in the circuit diagram. The UNO passes data to Nano with the use of mentioned protocols.

Arduino Nano receives the data and communicates with GSM module through UART protocol and depending on whether intrusion has occurred, notifies the owner.

HARDWARE/TOOLS

A. Hardware for Conduction

1) GSM SIM 800 Module
The GSM SIM800l Module is a GSM-based miniature cellular module which allows the user to send and receive SMS, call other phones, and receive calls.

Fig 2. SIM800l Wireless GSM Module

2) Arduino UNO Microcontroller
Arduino is a standard micro-controller based on ATmega-328P. It has 13 Digital I/O pins along with 5 Analog Input pins which allow functioning of all 3 communications protocol. The UNO board is the Controller/Master board for SPI and I2C communication.

Fig 3. Arduino Uno Microcontroller

3) Arduino Nano Microcontroller
Arduino Nano is based on ATMega-328 micro-controller and has 22 Digital I/O pins. The Nano is the peripheral/slave board in regards to SPI and I2C communication.

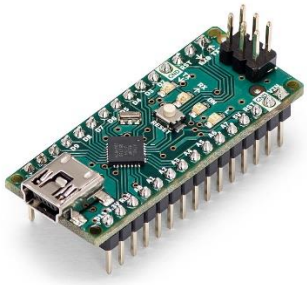

Fig 4. Arduino Nano Micro-controller

4) Infrared Sensor
The Infrared sensor is used to detect the break-in. The MH series IR sensor is implemented in the project, which can detect distances up to 30cm. The distance measured can be modified depending on the requirements using the potentiometer on board.

Fig 5. MH Series IR Sensor

5) Cellular device

6) LM2596 Buck converter
The main functionalities of a buck converter are to step down any particular given voltage to any desired voltage and provide a steady flow of current. In this project, it is used to provide the GSM module with constant power.

Fig 6. LM2596 DC-DC Buck converter

7) 2G/3G Compatible SIM

B. Software Environment:

Arduino IDE

Arduino IDE is used to write and edit codes for ATMega based micro-controllers. It provides multiple libraries and various other libraries can be added from outside sources. SPI and Wire libraries are used in this project for SPI and I2C communication respectively.

IV. Circuit Diagram

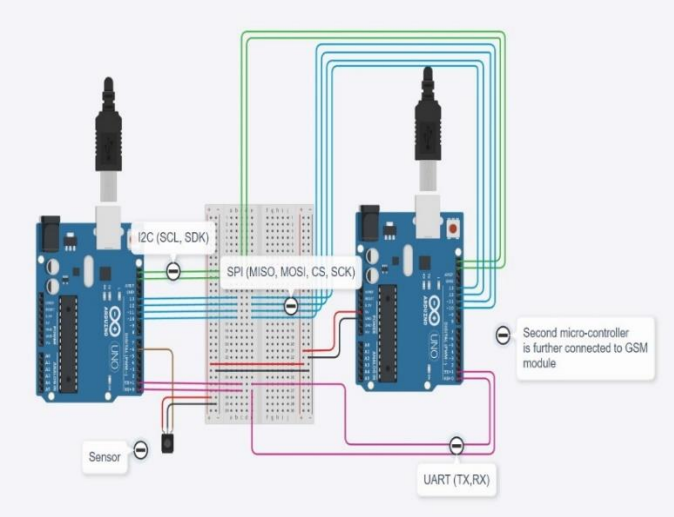

Fig 6. Circuit Diagram

Arduino Nano is used as replacement for the second UNO micro-controller illustrated in the circuit diagram in actual hardware implementation. The connections for different communication protocols are based on the pinouts of the board.

To facilitate I2C, SCL and SDK of UNO are connected to SCL and SDK of Nano. Similarly, for SPI, MISO, MOSI, CS and SCK are connected to their counterpart in the other board.

However, for UART, the Tx of UNO is connected to Rx of Nano and Rx of UNO with Tx of Nano.

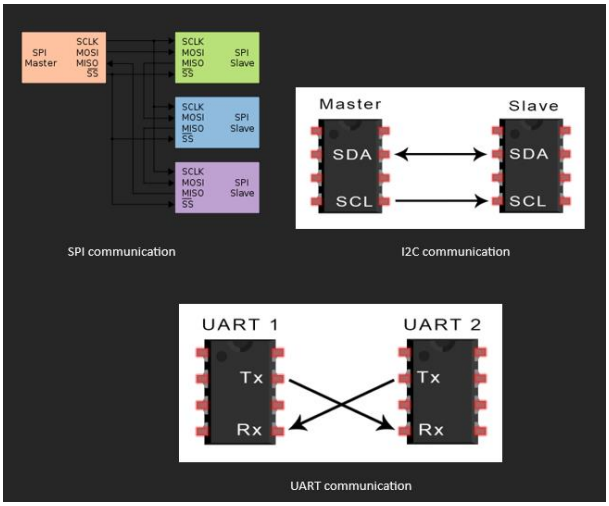

Fig 7. Communications for different protocols

The MH series sensor is connected to a digital input pin of UNO. It provides constant data at any user defined time interval. Nano is connected to the GSM module using UART communication. 5V and GND in the circuit is taken from Arduino UNO.

V. Result

The project is able to detect intrusion and transmit given data using SPI, I2C and UART communication. Once intrusion is detected, the owner is notified.

The figure below shows one such instance where intrusion is detected by the sensor using I2C communication. The 'Intrusion Detected!!' message is passed on using SDA and SCL pins as soon as the intrusion is detected by the sensor. Similarly, the message is also transmitted using SPI and UART.

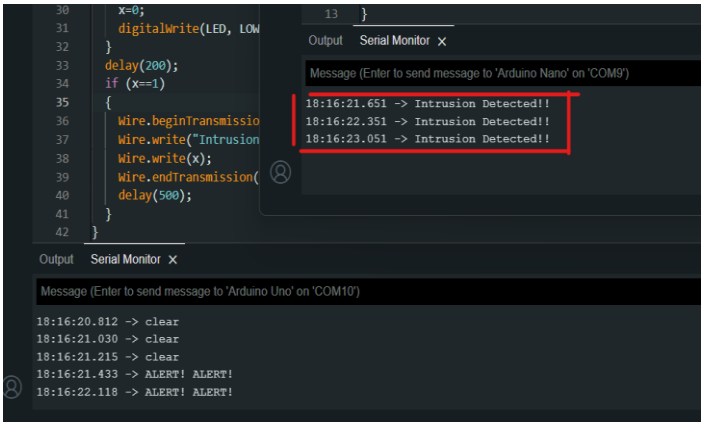

Fig 8. Alert message using I2C

VI. References

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