Congestion Avoidance System near Railway Crossing

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Abstract— The objective of this initiative is to control traffic congestion and monitor the status of railway crossing gates using microcontroller and concepts of IoT. This model is implemented using sensors that are placed at certain distance from the railway gates, which detects the approaching train and accordingly avoids traffic congestion along with controlling the operation of the gates. Concepts of IoT integrates google maps with the proposed system optimizing the path displayed on the google maps. For local masses, large display units shall indicate the arrival of the train and assist them to change routes.

Key words: Microcontroller, IoT, Sensors, Google Maps, Display Unit

I. INTRODUCTION

Considering largely populated countries like India, China etc. the usage of resources like petroleum and gas are of highest significance. Time is also an important parameter for people in all walks of life. Automobiles (Two wheelers, four wheelers, etc.) are major means of transport for the majority of the population. Along with these, India has the largest railway network in the world. As a result, there are many railway crossings and it can be seen people waiting at the railway crossing and this causes a lot of congestion. As of now, railway gates are operated manually with technicians waving flags and using certain hand signals and there are no alternatives for the congestion occurring near the railway crossings. Also the accidents at un-maned railway gates requires a lot of attention. In this model, we propose to rectify the congestion and also nullify the accidents at un-maned railway gates.

II. IMPLEMENTATION

The basic working of this model involves sensors detecting the arrival of the train at a particular distance from the railway crossing, upon which an alerting signal to the microcontroller is sent, which prompts the controller to close the gates and update the server and the display units. Another sensor on the farther side detects the departure of the train and reverts the statuses of the gate, server and display units to the previous normal conditions.

A. Arduino Development Boar

Arduino is an open source, computer hardware and software company. It also is a user community that designs and manufactures microcontroller development boards for building digital devices and systems that can sense and control objects in real time [1]. The Arduino products are distributed as Open-source hardware and software, which are licensed under GNU General Public License (GPL), hence making sure that anyone can manufacture and distribute Arduino boards and its associated software. Arduino development boards are available commercially in preassembled form or as do-it-yourself (DIY) kits.

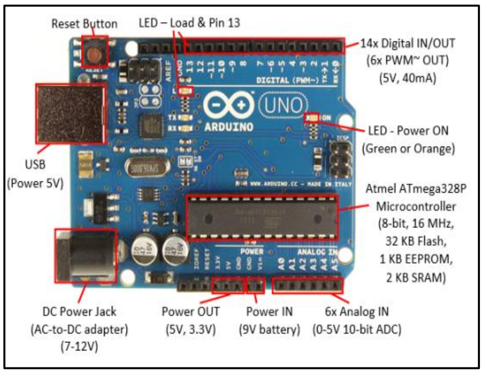

Fig. 1:

Arduino development boards use variety of Microprocessors and controllers. The boards feature set of digital and analog input/output (I/O) pins for interfacing with external world. An Arduino Uno board comprises of 14 Digital pins and 6 Analog pins [2]. The board is also equipped with serial communication interfaces, including Universal Serial Bus (USB) which are used to load programs from personal computers. The controllers are typically programmed using a dialect of features from C and C++ languages. Further, Arduino project provides an integrated development environment (IDE) based on the Processing language project along with the traditional complier toolchains.

III. PRESSURE SENSOR

The pressure sensor that is used in this model is BMP-180 based digital barometric pressure sensor module and is functional compatible with older BMP-085 digital pressure sensor with less power consumption smaller in size and more accurate. BMP180 combines barometric pressure, temperature and altitude. The I2C protocol allows for the sensor to be interfaced with any microcontroller very easily. The supply voltage to the board is the standard 5V which is regulated to work at 3.3V. BMP-180 can measure pressure range from 300 to 1100hPa (+9000m to -500m relating to sea level) with an accuracy down to 0.02hPa (0.17m) in advance resolution mode. BMP-180 uses piezo- resistive technology to sense the pressure. This approach brings about high accuracy, linearity, EMC robustness and stability for a longer period of time.

Fig. 2:

The BMP-180 module consists of a piezo-resistive sensor [3], an Analog to Digital Converter and a control unit with E2PROM and a serial I2C interface. The BMP180 delivers the uncompensated value of pressure and temperature. The microcontroller sends a start sequence to start a pressure or temperature measurement. After converting time, the result value (pressure or temperature respectively) can be read via the I2C interface. Calibration is required for calculating the pressure in hPa units and for these calculations the constants are read out from the EEPROM using the I2C serial interface at the time of initialization. The sampling rate of the ADC is variable can have a maximum of 128 samples per second.

IV. ESP8266

The ESP8266 is a low-cost Wi-Fi chip [4] with full TCP/IP stack and MCU (microcontroller unit). The works on a 32-bit RISC CPU: Tensilica Xtensa L106 running at a fast rate of 80 MHz It consists of 64 KiB of instruction RAM, 96 KiB of data RAM. The chip is provided with an External QSPI flash memory: 512 KiB to 4 MiB* (up to 16 MiB is supported). The module works on IEEE 802.11 b/g/n Wi-Fi standards and has provisions for WEP or WPA/WPA2 authentication and encryption protocols. It also has 16 GPIO pins which are multifunctional and can perform I2S DMA interfacing. It supports I2C and SPI serial interfacing to connect with any microcontroller unit. The module is equipped with a 10-bit ADC for high precision. There are Integrated TR switch, balun, LNA, power amplifier and matching network support[5]. Both the CPU and flash clock speeds can be doubled by overclocking techniques on some devices. The processor can be run at 160 MHz and flash can be sped up from 40 MHz to 80 MHz

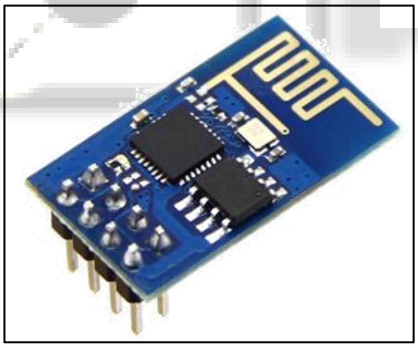

Fig. 3:

V. LCD (LIQUID CRYSTAL DISPLAY)

Each pixel of a Liquid Crystal Display typically consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters, one parallel and the other in the perpendicular direction, the axes of transmission of which are perpendicular to each other. Without the liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer. Before an electric field is applied, the orientation of the liquid-crystal molecules is determined by the alignment at the surfaces of electrodes. In a Twisted Nematic (TN) device, the surface alignment directions at the two electrodes are perpendicular to each other, and so the molecules arrange themselves in a helical structure, or twist. This induces the rotation of the polarization of the incident light, and the device appears grey. If the applied voltage is large enough, the liquid crystal molecules in the centre of the layer are almost completely untwisted and the polarization of the incident light is not rotated as it passes through the liquid crystal layer. This light will then be mainly polarized perpendicular to the second filter, and thus be blocked and the pixel will appear black. By controlling the voltage applied across the liquid crystal layer in each pixel, light can be allowed to pass through in varying amounts thus constituting different levels of grey. Colour LCD systems use the same technique, with colour filters used to generate red, green, and blue pixels. The display unit will get input from the controller either via wired communication or on a wireless media and then it will display the arrival of the train.

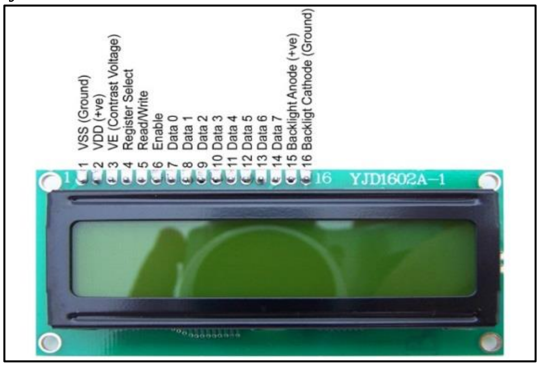

Fig. 4:

6. Interface pin description

Pin no.	Symbol	External connection	Function
1	Vss	Power supply	Signal ground for LCM
2	V_{DD}		Power supply for logic for LCM
3	V_0		Contrast adjust
4	RS	MPU	Register select signal
5	R/W	MPU	Read/write select signal
6	E	MPU	Operation (data read/write) enable signal
7~10	DB0~DB3	MPU	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCM. These four are not used during 4-bit operation.
11~14	DB4~DB7	MPU	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU
15	LED+	LED BKL power supply	Power supply for BKL
16	LED-		Power supply for BKL

Fig. 5:

VI. BLOCK DIAGRAM

The working of the model begins with an alerting input from the pressure sensor to the microcontroller which indicates the arrival of the train from any one of the two directions. The microcontroller is coded such that the arrival and departure sensors are dynamically determined since the train can travel in any one of the two directions.

Further, the microcontroller is the main unit of the model which detects both the arrival and the departure of the train and sends out required signals for the precise operation of the entire system.

Firstly, when one of the sensors gives an output that is above a threshold value, it indicates the arrival of the train and in this case the particular sensor becomes the arrival sensor. This indication is used by the microcontroller and it sends out a signal to close the gate at the particular railway crossing, simultaneously a message is sent to all the connected LCD units which are spread throughout the entire city along with updating the server via Wi-Fi to indicate the arrival of the train at that particular junction. With integration of IoT [6], the server update can be incorporated with google maps or any other such software and help in rerouting of the path.

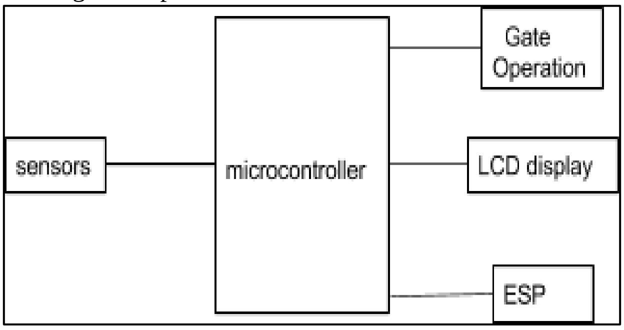

Fig. 6:

Secondly, the departure of the train is picked up by the other sensor whose mechanism is coded and this particular sensor is the departure sensor. The signal from this sensor to the microcontroller performs the following:

Open the closed railway gates

Update new information to both the server and the LCD units indicating the departure of the train.

Finally, the traffic operates normally and the people get to know that they can cross the junction without any delays.

VII. Conclusion

A pressure sensor produces appropriate voltage indicating to the microcontroller about the arrival of the train. The Controller then decides on the action to perform based on the application that running on it. The controller closes the gate and updates the current state in the server. The server that is integrated with Maps services assists the drivers to take alternative paths. The display unit shall display the state to the masses travelling without maps and help them in avoiding congested paths. This venture could be one of the initiatives of the “Smart City” project in India.

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