Homework 2: Project Proposal

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By
Zaher Ayyach
Rabih Ayyach
Adam Motola
Tuna Poanessa
Tsegaslase Mebrahtu

Project Ideas Descriptions

Pedestrian counter with an LED display (Project 1)

This device will consist of a motion sensor that will count the number of times people cross a certain point. It will be hooked up to an LED display which will show the number of times the path has been traversed. Every time a person walks by the motion sensor it will send a signal to the microcontroller which will then update the LED screen. In addition to that, the device will have a reset button which will reset the counter allowing the user to easily reuse the device in different locations or to gauge how many times people walk by a certain point in some period of time.

Parking Spots Counting System (Project 2)

Above every parking structure, we will have a motion sensor that gets activated when a car parks. After 10 seconds from the sensor getting activated we will send the data to a database, and then the display screen will show how many parking spots are available in real time. Input device would be the motion sensor, communication between the sensor database will happen over GSM and the output device would be the monitor that displays how many parking spots available over all.

SMS door lock/unlock (Project 3)

The input sensor to this device will be a SIMCOM Sim900 GSM module running on the T-mobile network. Communication between this module and a microcontroller will occur through a two-wire UART connection. The microcontroller will be able to send and receive SMS text messages, which will control the opening/closing of an electric door strike (Output).

Drum LED lights (Project 4)

This system would be designed to light up the different drums of a full drum kit whenever they are struck. This will require the use of microphones to detect frequency or vibration sensors to detect the strike of the drum. The signal would be used to light up LEDs mounted around the outer rim of the drum, illuminating it for brief a moment.

Aircraft communication receiver (Project 5)

The aircraft communication receiver will be designed to tune the **118-135 MHz** band. The receiver will pick up signals on ground and air communication related with commercial airlines and general aviation within about 130 miles (190Km). The receiver will be powered from a 9-volt alkaline battery. The receiver is a super heterodyne AM which is built around 4 ICs: a double balanced mixer (**NE602**), Linear IF amplifier (**MC1350**), Quad op-amp (**LM 324**), and audio amplifier (**LM 386**).

Criterion Pairwise Comparison Table and Decision Matrix

The following criterion were used to compare the project ideas that the team came up with:

A. **Technical complexity**: The relative ease or difficulty and the amount of research needed to make the product.
B. **Match to Team Skill**: How well the project design fits with the technical knowhow of the team.
C. **Development Time**: The amount of time it will take to produce a working product that can be demonstrated to the instructor.
D. **Versatility**: the number of uses that the product has.
E. **Cost**: The amount of money it will cost to produce one unit. The cheaper the product is to make the more desirable it is.

Before being able to use these criterion in a decision matrix they had to be assigned weights. The following method was employed to assign them these weights. The criterion were organized in a square matrix like the one shown below and were compared one to one. Each cell in the matrix corresponds to a comparison of a pair of items and contains the item that is considered the most important of the pair. If the criterion being compared are of equal importance both of the criterion are placed in the cell. After the whole matrix is filled out (aside from the redundant cells which make the same comparisons as other cells in the matrix) the number of occurrences of each criteria is counted. The number is then totaled and the following formula is used to find the weight of each of the criteria:

$$weight = \frac{number\ of\ occurrences\ of\ a\ criteria}{total\ number\ of\ occurrences\ of\ all\ the\ criterion}$$

Criteria	A	B	C	D	E	Weight
A		B	C	A	E	0.08
B			BC	B	BE	0.30
C				C	CE	0.30
D					E	0.2
E						0.30

After finding the weights of the criterion the data is populated into the weights column of the table below. The relative weights of each of the criterion with respect to the project idea is then filled in the appropriate cells. The rule for filling out each of the criterion is if the project fits well with the desired criteria than it should have a value closer to 1 than 0. Otherwise it should have a value closer to 0 than 1. For example if a project will cost a lot of money than it should have a value closer to 0 because the criteria requires that the product be inexpensive.

Selection Criteria	**Weights**	**Alternatives**				
		Project 1	**Project 2**	**Project 3**	**Project 4**	**Project 5**
A (Technical complexity)	0.08	0.6	0.3	0.7	0.5	0.1
B (Match to Team Skill)	0.30	0.4	0.4	0.9	0.4	0.1
C (Development Time)	0.30	0.5	0.4	0.7	0.5	0.1
D (Versatility)	0.2	0.6	0.2	0.9	0.2	1
E (Cost)	0.30	0.3	0.2	0.65	0.6	0.1
Score		**0.53**	**0.36**	**0.91**	**0.53**	**0.3**

After filling out the table the scores were computed using the following formula:

$$score = \sum the\ weight\ of\ the\ criteria * the\ relative\ weight\ of\ the\ criteria\ with\ respect\ to\ the\ project$$

Final Proposal - GSM SMS Door Latch

This project will allow the user to control the opening and closing of a door latch (electric door strike) through text messaging. Other major components needed for the hardware device include a GSM modem module, and a microcontroller. The microcontroller will communicate with the GSM modem to send and receive text messages, and to control the open/close state of the electric door strike.

A preliminary BOM (bill of materials) for the project is as follows:

- SainSmart Sim900 module ~$20
- Atmel ATMEGS328P-PU microcontroller (or -AU for surface mount) ~$2
- Electric door strike ~$30
- AC/DC 9V adapter "wall wart" ~$7
- 2.1mm DC power jack ~$.50
- 16MHz crystal ~.50
- 22pf ceramic capacitor (surface mount if possible) (2x) ~.20
- 10µF electrolytic capacitor (surface mount if possible for this high a value) (2x) ~.50
- 10kΩ SMD resistors (surface mount) (at least 1) ~.50
- 7805 5V linear voltage regulator in TO-220 package. (Smaller TO-92 package does not provide enough current to the Sainsmart Sim900 module when sending SMS messages.) ~$1
- GSM Sim Card ~$9
- Monthly Sim Card service with SMS messaging ~$10
- Enclosure, possible an aluminum Hammond 325b enclosure ~10
- Waterslide decal ~$3
- Printing on waterslide decal from REDe Print n Shop near PSU ~$2

$$Total\ cost \leq \$100$$

The project is powered by a 9V DC adapter, which feeds into a 5V linear voltage regulator, through which 5V DC is provided to the Atmel microcontroller, the SainSmart GSM module. The power scheme may be updated once we pick a specific electric door strike, which requires a power supply. The larger capacitors regulate the power supply, and the smaller form a clock with the 16MHz crystal.

The project will run on a Ting SIM card, which runs on the T-mobile network. Service costs $6 a month plus several dollars for SMS messages and taxes.

The microcontroller will communicate with the GSM module through a UART line. The Sainsmart module drops the 5V supply to ~4V, which is needed to power the SIMCOM Sim900 module on board. Incoming SMS messages trigger communication with the microcontroller, which can respond according to code.