MAE 476/576 Mechatronics

Mini-Assignment 1

Theme: Integration of Ubiquitous Computing, Communication, Sensing & Actuation

PART 1

Digital Camera

- The camera of yesteryears with its bulky flash arrangement, the multiple dials for focusing, the laborious rewind process and the poor quality of pictures---was definitely not user friendly. Taking pictures of intimate moments was more of a pain.

- But with ubiquitous computing, communication advancements and new sensing techniques the camera is now user friendly.

A device that will sample the original light that bounces off your subject to create a digital image. This device is called a **digital camera**.

A digital camera is the easier and faster path to take.

Agrawal, Rajendra

Sensing

- It has a sensor that converts light into electrical charges. The image sensor employed by most digital cameras is a **charge coupled device** (CCD).
- In a CCD device, the charge is actually transported across the chip and read at one corner of the array. An analog-to-digital converter turns each pixel's value into a digital value.
- In order to get a full color image, most sensors use filtering to look at the light in its three primary colors. Once all three colors have been recorded, they can be added together to create the full spectrum of colors
- If a camera says it has 2.1 megapixels, then there really are approximately 2,100,000 photosites on the CCD.

Communication

- Early generations of digital cameras had fixed storage inside the camera. Although most of today's cameras are capable of connecting to a serial, parallel, SCSI, and/or USB ports, they usually provide you with some sort of removable storage device.
- I can now download whatever pictures I take straight on to my computer and send it to the world over. This is the power of communication in present world.

Actuation and Computing (The processor does it all)

- A camera lens collects the available light and focuses it on the sensor. Most digital cameras use auto-focus techniques.

- Autofocus mechanism of the camera works like an actuator. A typical autofocus sensor (CCD) provides input to algorithms that compute the contrast of the actual picture elements. The CCD is typically a single strip of 100 or 200 pixels. Light from the scene hits this strip and the microprocessor looks at the values from each pixel.

- The microprocessor in the camera looks at the strip of pixels and looks at the difference in intensity among the adjacent pixels. If the scene is out of focus, adjacent pixels have very similar intensities. The microprocessor moves the lens, looks at the CCD's pixels again and sees if the difference in intensity between adjacent pixels improved or got worse. The microprocessor then searches for the point where there is **maximum intensity difference** between adjacent pixels -- that's the point of best focus.

Summary

- Digital cameras come in forms small enough and versatile enough to perform almost all of the tasks that conventional cameras can perform, and they can do quite a few things that conventional cameras cannot. The digital camera is ideal for creating pictures that you can e-mail to friends or post on the Internet.

Agrawal, Rajendra

References used and some more great Links for the product-

- [Kodak Digital Learning Center](http://www.kodak.com/US/en/digital/dlc/)
  http://www.kodak.com/US/en/digital/dlc/
- [DigitalCameras.com](http://www.digitalcameras.com/)
  http://www.digitalcameras.com/
- [A-Digital-Eye.com](http://www.a-digital-eye.com/)
  http://www.a-digital-eye.com/
- [Digital Photography Review: News, Reviews, Forums, FAQ](http://www.dpreview.com/)
  http://www.dpreview.com/
- [Digital Camera Reviews](http://www.image-acquire.com/camera/index.shtml)
  http://www.image-acquire.com/camera/index.shtml
- [InfoPool: Digital Cameras](http://www.compar.com/infopool/articles/news1vs3.html) : http://www.compar.com/infopool/articles/news1vs3.html
- [Digital Cameras Buyers Guide](http://www.digital-camerastore.com/)
  http://www.digital-camerastore.com/
- [PC Photo Review](http://www.pcphotoreview.com/)
  http://www.pcphotoreview.com/
- [Digital Camera Resource Page](http://www.dcresource.com/)
  http://www.dcresource.com/
- http://www.howstuffworks.com/digital-camera1.htm

By: RAJENDRA AGRAWAL
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Agrawal, Rajendra

Robomower "Smart Enough to Mow Your Yard – Dumb Enough to do it for Free!"

Mows lawn automatically, and independently, without human intervention

Commercial introduction – June 2000

www.robot-lawnmower.com/index.html

Bechtel, Jonathan B.

Robotic lawn Mower

- **Ubiquitous Computing**
  - A 16 bit, 24-MHz Hitachi microprocessor
  - 128 KB RAM and 512 KB upgradeable flash memory
  - The software processes the input (a lawn of given size and shape) and determines the most efficient path the mower should take to cut the grass

- **Communication**
  - Graphical User Interface
  - Waterproof LCD Display
  - Audio warnings, will talk to you
  - Manual Override using Remote Control
  - Consumer installs a perimeter wire to communicate to the mower the location of the lawn boundary

- **Actuation**
  - 24-volt system, comparable to 5 hp gasoline mower
  - Two independent, geared wheel drive motors

- **Utility**
  - Mows your lawn effectively in a reliable and efficient manner

Bechtel, Jonathan B.

- **Sensing**
  - 10 sensors (2 collision, 8 within bumper)
  - When bumper hits an object, the impact sends a puff of air through a hose to a diaphragm on the computer sensor board, the mower stops, backs up and then turns right or left to continue mowing
  - Two proximity sensors tell the mower to slow down when is comes to within 3 feet of an obstacle
  - A lift sensor shuts off the blade rotation if someone tries to raise the lawn robot
  - Its navigational system is a floating compass that uses two settings for forward and backward direction
  - When the mower senses the perimeter wire it knows it can't go any further

- **Utility**
  - Mows your lawn effectively in a reliable and efficient manner

- **Added Functionality**
  - The mower's menu option offers a safety feature preventing young children from operating the mower
  - Blades automatically shut off when unit is lifted just ¾"
  - Can program in a security code and on/off times for the operation

Robotic lawn Mower

Advantages

- Cost Savings:
    - Pays for itself in less than two seasons
    - Allergy sufferers will not have to buy masks and filters
    - Elderly do not have to deal with costly, unreliable lawn mowing services
    - Annual electric cost of $7.00
- Noise Reduction:
    - Quiet enough to run at night, as loud as a hairdryer
- Physical alleviation
    - Beneficial to anyone suffering from allergies, physical limitations, or the elderly
- Time Savings:
    - More quality time with children
- Safety:
    - Provides for physical separation between human and lawn mower

Disadvantages

- Only cuts about ¼ of an acre
- A lawn greater than a third of an acre will need an extra battery pack
- Need two robomowers for lots greater than a ½ acre
- May not mow the lawn in the smartest fashion, takes 4 to 5 hours

Bechtel, Jonathan B.

INTELLIGENT FIRE DETECTION SYSTEM

By
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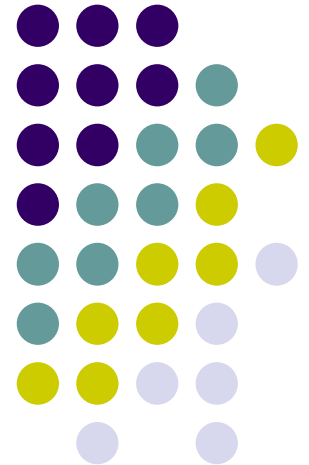
Motivation

- Future fire detection systems should have the ability of discriminating signatures between fire and non-fire sources, because nuisance alarm problems have plagued existing smoke detectors. In high value installations such as semiconductor clean rooms and telephone central offices, it is obvious that reliable fire detection systems are needed, since usually these detection systems are used to activate fixed fire suppression systems, and false discharges are certainly undesirable. False alarms can cause unnecessary down time and undermine the operator's confidence in the monitoring systems

Bhabhrawala, Talib Saifuddin

Conventional fire alarm systems

- Conventional fire alarm systems have a hard wire layout and normally opened warning devices like heat detector and smoke detector in general specifications which directly activate an alarm.

Advantages
- Low cost

Disadvantages
- Low efficiency to warn and to communicate to a human being.
- Can provide only a Yes or No response.
- Hard expansion and transformation of working.
- No record and no database to develop in the future.

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System *Architecture*

- Input signal coming from the normally opened warning devices such as heat detector, smoke detector and master key is sent into a detectable instrument to separate the mode of working state.

- The output signal is dispatched to microcontroller for analysis. This microcontroller can transfer data and display the situation of detector in a zone. Thus, the calculated output data is exposed on PC.

- In case of fire mode, the data will be sent to PC and to bell simultaneously. Delay time of signal message can be changed directly and easily by PC. In addition, all information including mode of state, date and time are recorded to be database for further analysis that is benefit for the development of fire alarm system to possess both more efficiency and more accuracy. In case of fire mode, sensor will detect signal of fire depending on its kind of detection.

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Conclusion and Future Work

- The controller possesses not only more efficiency but also more accuracy.

- The fire alarm system, furthermore, is more convenient to control and to installation.

- Because all information such as the characteristic of working state, date and time in each part of day are recorded, hence, this is useful not only for revisory but also improving the further fire alarm system.

- The embedding of the system into the internet can add a whole new dimension and increase the communication and response capabilities manifold.

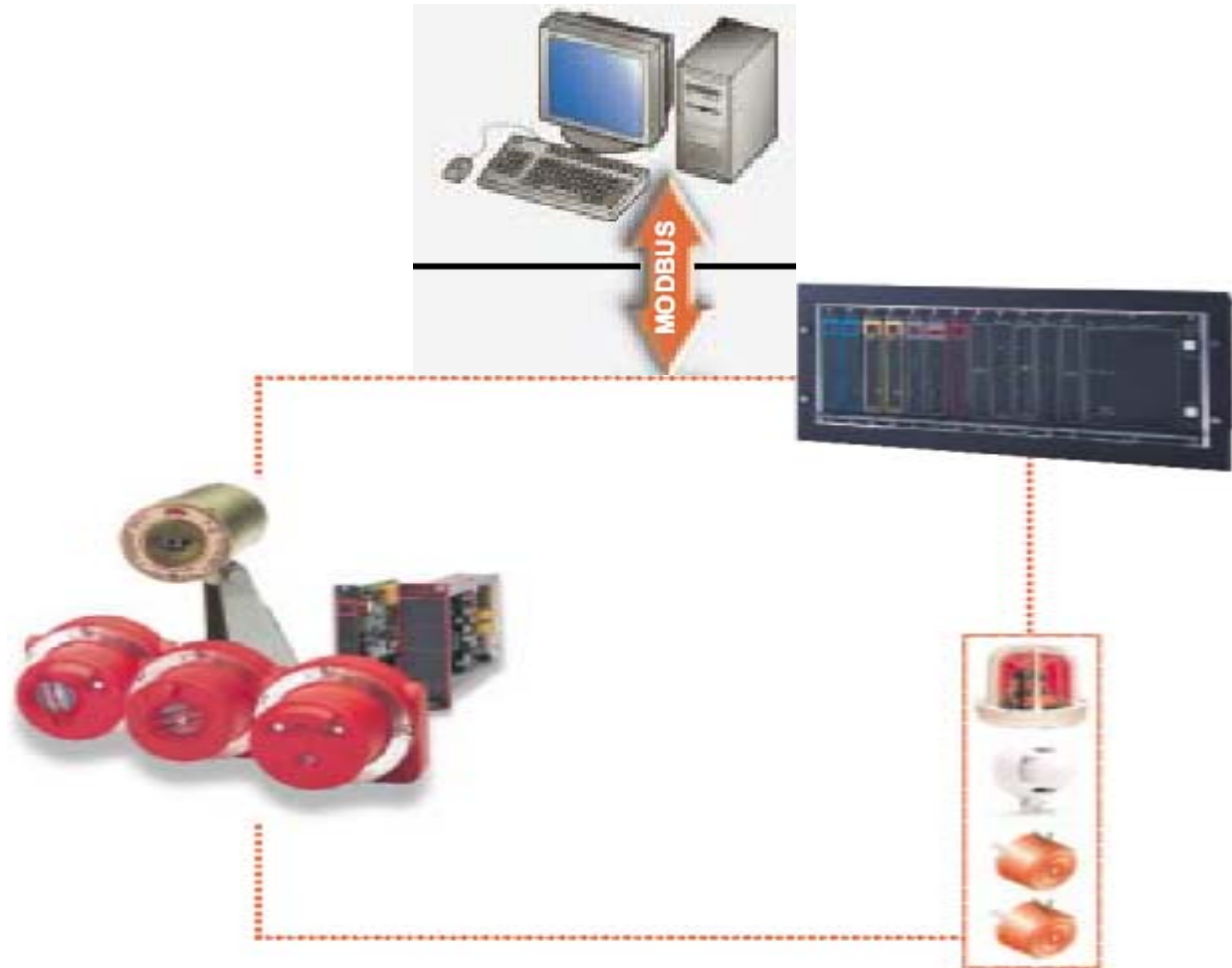Bhabhrawala, Talib Saifuddin

Network Layout

Bhabhrawala, Talib Saifuddin

Figure 4 : Output data of detector in each zone

Bhabhrawala, Talib Saifuddin

References

- http://www.hometeam.com/beta/9908control.shtml
- http://www.techexpo.com/WWW/opto-knowledge/intelli-fire.html
- http://accelconf.web.cern.ch/AccelConf/ica99/papers/mc1p47.pdf
- http://www.generalmonitors.com/downloads/literature/flame/NFPA.PDF

Bhabhrawala, Talib Saifuddin

Hewlett Packard LaserJet 4050

© 2001 How Stuff Works

- Works on the principle of <u>static electricity</u> , a electric charge built on an insulated object.

- Photoreceptor : A revolving drum or cylinder made of highly photoconductive material, is initially positively charged by passing electricity through a Corona Wire. This can be considered as an actuator form the entire printing process.
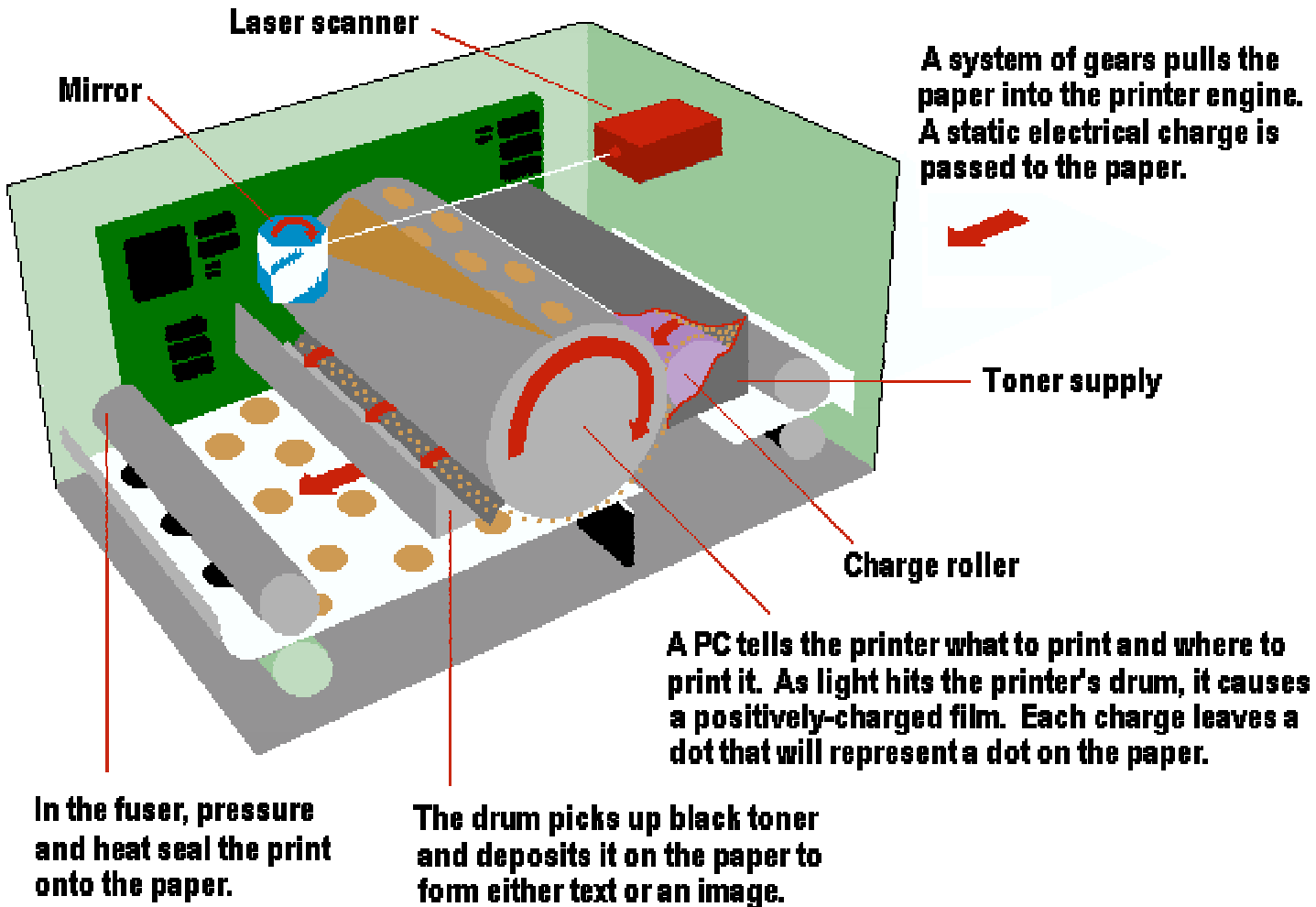
Boddu, Rajani

Laser Scanning Unit

Developer Roller

Toner Hopper

Corona Wire

Discharge Lamp

Photoreceptor Drum Assembly

Fuser

Paper

Corona Wires

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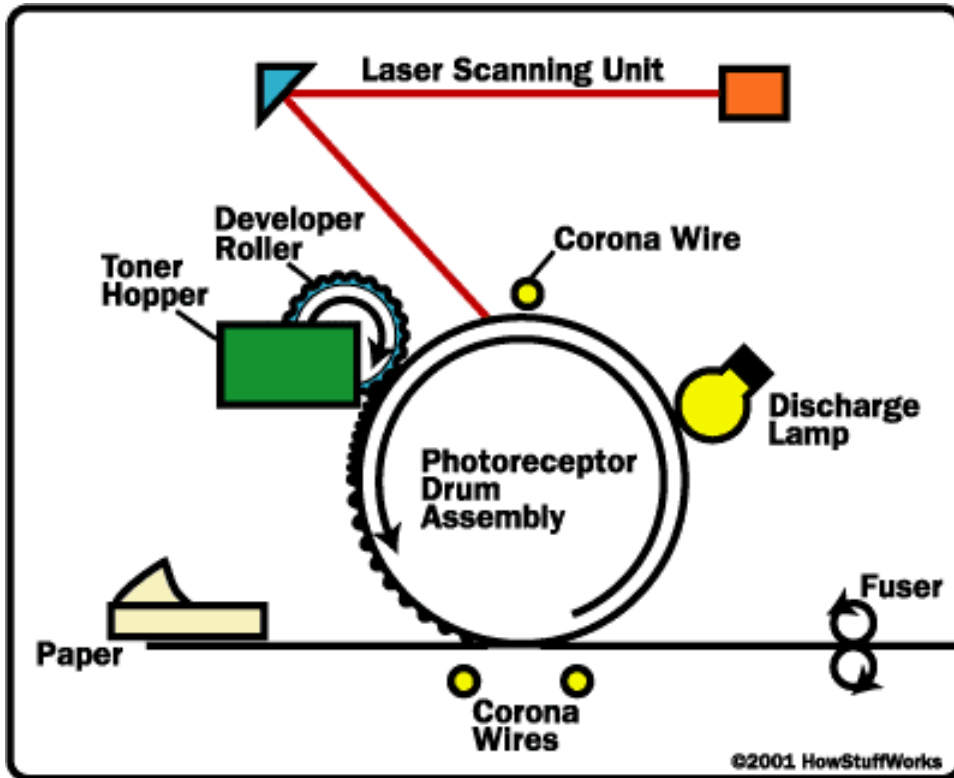
Components of a Laser Printer

Boddu, Rajani

- Printer Controller: Present on main board of the printer. Organizes all the data received from the computer e.g. type of paper, paper layout,type of font etc. It has a Raster Image Processor which splits the entire data into an array of tiny dots. It can store the print jobs into its own memory and deals with them one at time.

- Communication port: It has a USB or parallel port to communicate with the host computer for exchanging data.

Laser scanner

Mirror

A system of gears pulls the paper into the printer engine. A static electrical charge is passed to the paper.

Toner supply

Charge roller

A PC tells the printer what to print and where to print it. As light hits the printer's drum, it causes a positively-charged film. Each charge leaves a dot that will represent a dot on the paper.

In the fuser, pressure and heat seal the print onto the paper.

The drum picks up black toner and deposits it on the paper to form either text or an image.

Boddu, Rajani

Working of a Laser Printer Fig(ii)

Why prefer a Laser Printer rather than an Ink-Jet Printer?

• It prints with a greater speed; *Speed*

• Laser Beam being of constant diameter writes without spilling ink; *Precision*

• 600dpi resolution; *Output quality*

• *Mechanically and Processing Efficiency*

• Almost comparable with the price of an Ink-Jet Printer.

  Laser Printer may be expensive for personal use but are perfectly suited for official purposes as they are used for printing long text documents,often referred as " Work Horse".

References: http://www.howstuffworks.com/laser-printer5.htm

  fig(ii)- http://www.pctechguide.com/12lasers.htm

Submitted By: Rajani Boddu (# 3046-7360)

Boddu, Rajani

Benefits of Ubiquitous Computing: Automated Toll Collection

Homework #1

Craig Cole

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16 January 2002

Cole, Craig Lawrence

Toll Collection becomes Automated

- **Integration of Ubiquitous Computing**
  - Cars are outfit with inconspicuous electronic RF transponder "tags" indicating their passage through toll lanes.
  - Existing toll booths are outfit with sensors to detect the tags, and charge the appropriate toll to the person associated to the tag
- **Communication, Sensing and Actuation**
  - "Tags" are actually RF transponders that are activated and read as they pass through toll lane.
  - Tolls are deducted from accounts accessible through the Internet
  - Indication of successful read is indicated to driver through large matrix displays. Toll barrier, if it exists, is raised.
  - Low balances and other messages can be communicated to the driver.

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Benefits of Automated Toll Collection

- Reduction of time spent in line at toll booths.

- Reduced vehicle emissions.

- Better information regarding usage of roadways and bridge crossings.

- More efficient use of existing toll plazas.

- Careful control of toll pricing may lure drivers to alter driving habits to reduce road congestion.

Cole, Craig Lawrence

Interesting Links

- [Smart Card White Papers](#)
- [Excellence in Highway Design Award](#)
- [Tag Intelligence Begins To Boom](#)
- [How Stuff Works](#)
- [List of Automated Roadways & Crossings](#)

Cole, Craig Lawrence

Computerized Appliances

John Eddy

In the past 4-5 years, large companies such as GE, Pioneer, Whirlpool, and Sony have began initiatives to create networked home appliances.

Such appliances will no longer be passive objects in a home but will become active agents that can be controlled from remote locations.

Some examples of the capabilities of such a system are:

- The ability of a refrigerator to find recipes based on what it knows to be in it.

- The ability of an oven to look up the optimal baking settings for an item and then cook it.

- The ability of a person to control the oven, microwave, or air conditioner from anywhere using a cellular phone so the house is cool and dinner is hot when they get home (even if they didn't know what time that would be when they left the house).

Network of LG Electronics

Consider the network available from LG Electronics

This home network can link lighting, entertainment, security, telecommunications, heating and air conditioning into one centrally controlled system.

A central microprocessor (computer) receives signals from controlling devices, then forwards those signals to the appliances and systems in the house you want controlled.

http://www.lge.com

John Eddy

Network of LG Electronics

The user can interface with the system via keypads, touch screens, panic buttons, TV screens, computers, telephones, handheld remotes or other devices.

Through sensing, the network can determine the state of the home as well as the operational state of the various networked components. So for example, the home-owner can be warned when service is necessary.

Through actuation and logic, the network can maintain the desired state of the home.

http://www.lge.com

John Eddy

Computerized Appliances

Given the commonality of each of the appliances and other components and the increasing ease with which networking can be accomplished, it is a natural next step to connect and coordinate them.

The potential economic benefits to companies that offer such networks are great as evidenced by the large number of companies pursuing such projects.

John Eddy

Mini Assignment 1

Sai Krishna Prasad, Gavirneni
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Magnetic Stripe Reader & Writer

CREDIT CARD READER

Magnetic Stripe Readers (MSR), Credit card readers, swiper readers and slot readers, card reader and card writers by ID Tech, designed to read and write the magnetic stripe data on credit cards, debit cards, driver's licenses, and ID cards, etc

- Reads magnetic stripes
- Writes to magnetic stripes
- Verifies magnetic stripe data
- Configures with Windows-based operating software
- Three LED inicators   [1]

Incorporation of Ubiquitous Computing, Communication, Sensing and Actuation:

1. The reader is provided with the vast data of information regarding all the banking cards in service that is enabled by Ubiquitous Computing. Without incorporation of Ubiquitous computing it would be a lot difficult to the computer to transfer all data every time from the banking resource center and would delay the process.

2. The card reader simultaneously online resources of banking and other systems to get the current status of the credit card i.e.., Whether the card condition is safe or stolen, or cancelled, etc. So communication plays a major role in credit card access system as it makes the credit card accessing without loopholes.

3. Sensing: As the card is inserted in to the machine it senses automatically the bar codes, or numbers given on the card so that it gets information about the card for further information.

4. Ones it senses and verifies the data related to the card and checks its status online with the banking system, then it actuates and enables the transfer of credit. It will also provide a transaction and balance information receipt.

All the four components together make the credit card reader service available to a customer. With the absence of either of them would diminish the quality of service or completely obstruct the automatic accessing system.

Credit Card Reading Machine has resulted in an improved system of banking because it eliminates the necessity of a user to go to the bank that is far away. When banking centers are few it would be much difficult for the customer to carry out his transactions. Since credit card Readers can be installed at any place without much equipment and finance they will save time for customer. Ubiquitous presence of credit card readers like in shopping centers it would be a much more comfortable for the user to carry out his transactions and he would be delivered from the burden of carrying bundle of cash in his pocket for a big marketing.

Gavirneni, Sai Krishna
Prasad

We can seen the economic impact in most of the products incorporated with above four systems e.g. in industrial applications, thermostat, motor control save energy , process control saves time which will show its Impact on economy probably to a great extent.   In the consumer items too, Microwave oven, automatic lighting, etc. will result in saving in energy which if counted on a nation wide would definitely show a greater economic impact.

The Credit Card Reader because of its fast and ease in facility would boost marketing and use of banking utilities. So use of it must have resulted in the economic impact in the most.

Gavirneni, Sai Krishna
Prasad

Relevant links:

[1]   http://www.semicron.com/reader-writer.html

Gavirneni, Sai Krishna
Prasad

- **MinorChecker® System:**The MinorChecker® System is a free-standing unit designed to help retailers minimize their risk from underage purchasers of alcohol or tobacco. This unit can scan the magnetic stripe from a driver's license and quickly indicate the card holder's age status (Age OK or Minor) with a visual and audible indication.

- **Accessories:**Positive Access has magnetic stripe readers and two dimensional bar code readers available for use with our driver's license reading software products. We have this equipment available for trial use when evaluating our software.

Gavirneni, Sai Krishna Prasad

IC's in the Kitchen

Nicholas Gill

MAE 576

1/28/03

Factors effect Diet

- Americans are now more health conscious.
- No time to cook well balanced meals.
- Eating at restaurants often is seen as unhealthy.
- Home cooked meals are cheaper than pre packaged foods and restaurants.
- Taste is penultimate importance
- Many people are confused on proper cooking techniques.

Current Kitchen Mechatronics The Microwave

- **Advantages**
  - **Fast cooking**
  - **Timed cooking-**
    - **cook time can be adjusted to when the person will come home.**
    - **Food can be left unattended without burning.**
  - **On screen instructions such is "flip food"**

- **Disadvantages**
  - **Bad taste/ texture**
  - **The "Chef" must be knowledgeable on how to use the microwave**
  - **The "Chef" must prepare the food for the microwave.**

Current Kitchen Mechatronics
The Bread maker

- **Advantages**
  - **Great tasting bread**
  - **Very little labor demanded from the "Chef"**
  - **Uses raw ingredients-flour, sugar-hence the food is cheap.**

- **Disadvantages**
  - **Limited to the output of bread**
  - **Ingredients must be loaded into the machine for every loaf.**

Combine Bread Maker and Microwave.

- The user loads basic ingredients into the machine.
- Maybe future version have large hoppers where the ingredients can be dispensed.
- There are preset recipes or downloadable recipes from a website for the machine to follow.
- Internal mixers and heaters prepare the food for a pre-set time.

Electronic Engine Control System

These devices are used in captive power plants where prime movers like turbines or engines are required to run in synchronized mode and share load.

Hydraulic Governor

Electronic Governor

Jadhav, Chetan

Chetan Jadhav

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Electronic Engine Control System

Hydraulic Governor

- Mounted on engine
- Takes input directly from fly wheel of the engine
- Separate devises are required for over speed protection and critical speed over ride.

(Critical speed override is required to prevent engine from running at its natural frequency of vibration)

Electronic Governor

- Fitted in engine control room
- Input can be the frequency of the electricity generated
- Critical speed over ride and over speed protection can be programmed in a an electronic governor with no extra devices required.

Jadhav, Chetan

Electronic Engine Control System

Hydraulic Governor

- Experts are required for maintenance

- Calibration requires experience or a lot of trial and error procedure.

- Expensive device since a lot of precision mechanical components required.

Electronic Governor

- Generally not required even if required engine operator with little training can change faulty circuit board.

- Engine operator can set parameters by connecting hand held device.

- Not expensive since electronics used is relatively cheap.

Jadhav, Chetan

Smart Wristwatches

IBM Watch with Linux OS (version 2.2)

> 8 MB Flash memory, 8 MB DRAM Memory

>Both IR and RF connectivity,

> touch sensitive display and a roller wheel

> Facility to view emails, Calendar, Address-book ,
   to-do list, weather information, traffic conditions,

Joshi, Preeti Sadanand

Wristwatch with cell Phone (Samsung)

> 60 hours standby time, 90 minutes talk time
> Storage of 2,000 addresses, Calendar entries for a year
> 80,000 word English-to-Korean Dictionary
> Scientific Calculator
> Voice inputs for commands
> Browse Internet through WAP browser , Wireless faxing
> Email checking

Wristwatch with an MP3 Player (CASIO watch)

> Built-in USB interface for high speed data communication
> Download MP3 Files from Internet
> 33 minutes of high fidelity Music
> Play Music for 4 hours
> Song title on the display
> Motion Graphics on screen to match song playback

Joshi,

Smart watches (Links)

1) IBM: Linux on Wristwatch
http://www.research.ibm.com/WearableComputing/factsheet.html

2) Microsoft's Smart Personal object Technology Wristwatches
http://www.microsoft.com/presspass/features/2003/jan03/01-09SPOTWatches.asp

3) Wrist Watch Cell Phone &
http://h18000.www1.hp.com/rcfoc/19991129.html
http://h18000.www1.hp.com/rcfoc/19991101.html

4) MP3 audio wrist watch
http://www.casio.com/watches/product.cfm?section=16&product=1713&display=
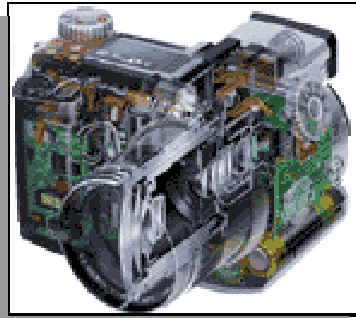
Name: Preeti Joshi Email: psjoshi@acsu.buffalo.edu

Joshi, Preeti Sadanand

MECHATRONICALLY ENHANCED SYSTEMS : DIGITAL CAMERA
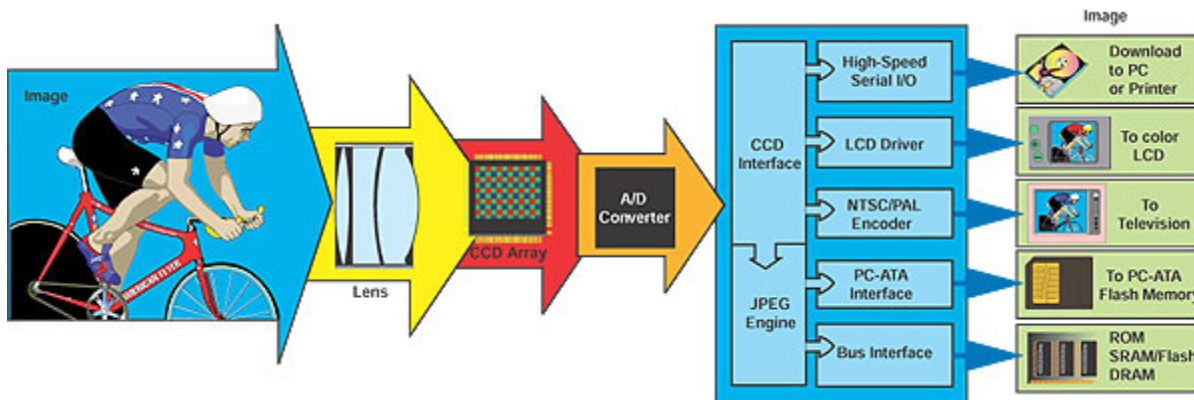

Anatomy of a digital camera

How different from a conventional camera?

- The process of picture formation ; picture is taken by the measurement of electric signals from charge coupled device(CCD) which has light sensitive diodes or photo diodes on them.
- Greater the number of diodes on CCD , greater the quality of picture.
- Pictures can be stored in a separate medium .
- Digital zoom capability in addition to optical zoom.

Kandula, Madan Mohan Reddy
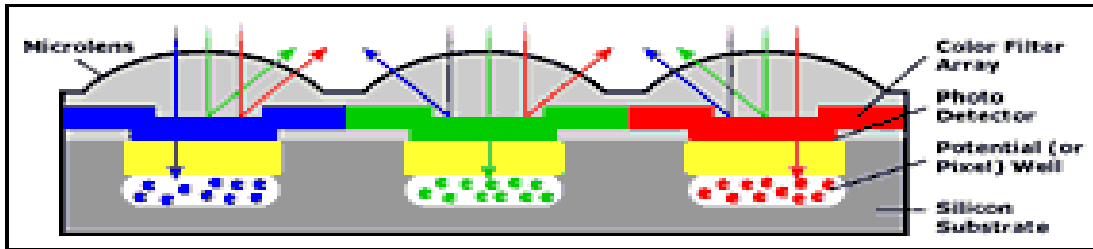
bayer pattern

In the above picture, the rays that are only perpendicular to the photo-sensitive diode are focused and sensed and those that are not are reflected away. The three primary colours proportion are measured and pixel colour is determined.

the process flow in a digital camera

Kandula, Madan Mohan Reddy

what to expect from this enhaced product !!

- Much Better image quality.
- The ability to move this image data from the camera to computer to web.
- The economy on having only the pictures which you only need to have as digital and the convenience to take a print out of the picture you need.
- The ease of operation.

Current technology in digital camera's

- Capability to capture images with 5 Mega Pixel class sensors.
- Smaller size cameras with more powerful features.

What has changed in this camera?

- Using the body of conventional camera and the principle of focusing images , the integration of sensors and micro processing elements with added features resulted in a new product.
- Conversion of an older mechanical sytem into a mechatronic system.

Aspects where further development possible

Kandula, Madan Mohan Reddy

- A possible product where a digital camera is a part of your compact lens or glasses.
- Further increase in the number of pixels formed for a picture for improved enlargement quality.
- Another possible idea is to have a sphere which can take 360 degrees image where the picture is world view rather than 2D.

References :

1) http://www.extremetech.com/article2/0,3973,15466,00.asp
2) http://photographytips.com/page.cfm/444

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Kandula, Madan Mohan Reddy

MINI ASSIGNMENT 1:

Product Segment: Industrial Robots

Submitted by:

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UB Person No: 3059-5804

Industrial Robots: application areas

- Wide range of application areas e.g. welding, machine tending, material handling, picking, packing, painting and assembly

- Relieve humans from tedious tasks or replace specially built machinery which tends to be inflexible if redesigned parts are to be handled

Kimothi, Gaurav

Industrial Robots: application areas (cont…)

- Washable robots for food industry

- Robots for severe environments like instance foundries

- Much more robust than human beings

Kimothi, Gaurav

Industrial Robots: implementation of advances in computing, communication, sensing and actuation

- The boundaries of robot programming have been extended

- Better sensors

- Development in actuation devices

- Implementation of all of these has led to more effective and efficient robots

- A significant economic impact for both the manufacturers and the users of industrial robots

Kimothi, Gaurav

Industrial robots: relevant links

- http://www.abb.com/robots
- http://www.machinebrain.com/Industrial_Robots/
- http://www.roboticsonline.com
- http://www.comaupico.com

Kimothi, Gaurav

MICROWAVE

- ## HEAVY DUTY

Used for long time and higher temperature applications.

- ## LIGHT DUTY

Used for short time and lower temperature applications.

Kulkarni, Amol
Madhukar

FEATURES

- 2000 W surge capability
- Over voltage protection
- Under voltage protection
- Overload protection
- Thermal protection
- Totally silent operation
- Triple AC outlets
- Remote Switch available.

Kulkarni, Amol
Madhukar

FEATURES

- TIME SET
- TEMPERATURE SET
- DIGITAL CLOCK
- AUTOSTOP
- ALARM BELL

Kulkarni, Amol
Madhukar