Automated Tool Monitoring System

MAY 1631

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Problem Statement

- Misplacement of tools in the tool chest
- Tools don’t get returned to the tool chest
- Monetary loss due to tool theft or misplacement
- Time loss due to extra effort put in finding the tools

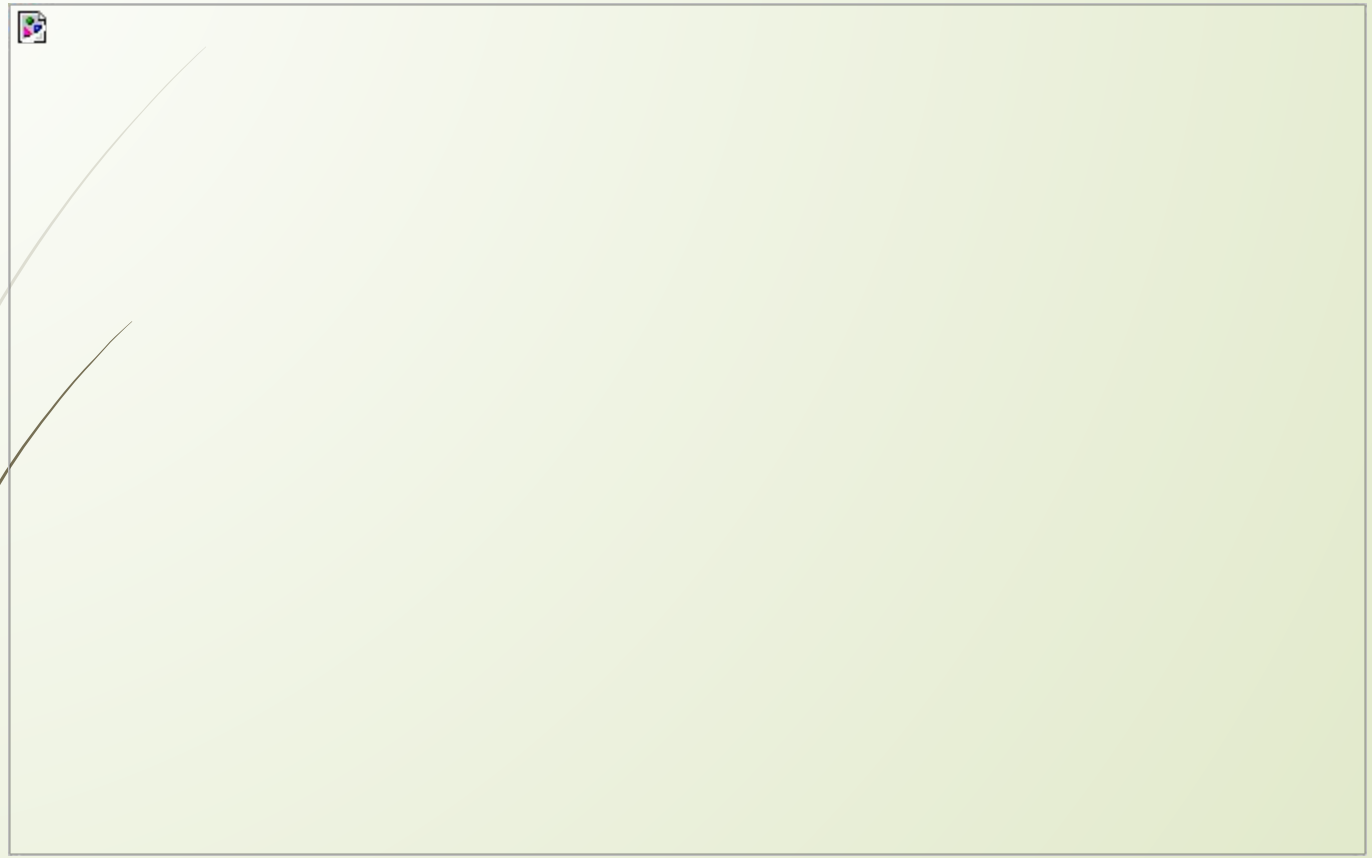
Solution

- Tool chest which monitors the number of checked out tools
- Maintains a database of who checked out the tool
- Stores video surveillance of the transaction
- Only authorized personnel open the tool chest.

Scope

- One drawer is going to represent the extendability of the template creating for each draw and the following vision detection.
- Complete database and website implementation.
- Complete authorization check and linking to the website.
- 3D model of the lock mechanism for the toolchest and sensor communication.

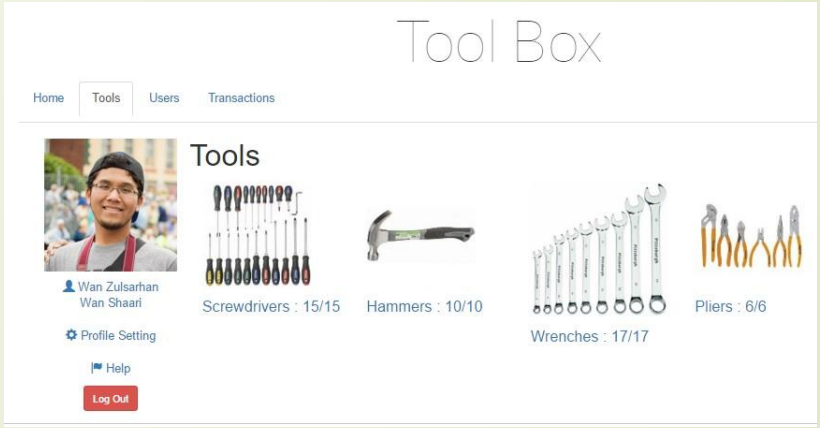
Block Diagram Design



Design

Main Processing Unit
(Raspberry Pi)

Image Processing Unit
(MyRIO)



Web Application

Main Processing Unit (MPU)

Raspberry Pi

Authorization

Validate user ID with database

Interface with Image Processing Unit

Record Video

Lock and Unlock Tool Box

Interface with servo

Create new Record in Database

Image Processing Unit (IPU)

Detect Tool Taken or Returned

- Through image processing and analysis

Interface with Main Processing Unit

- Report to the **MPU** the number of tool missing for the recent transaction
- Done through Digital Pins

National Instrument MyRIO

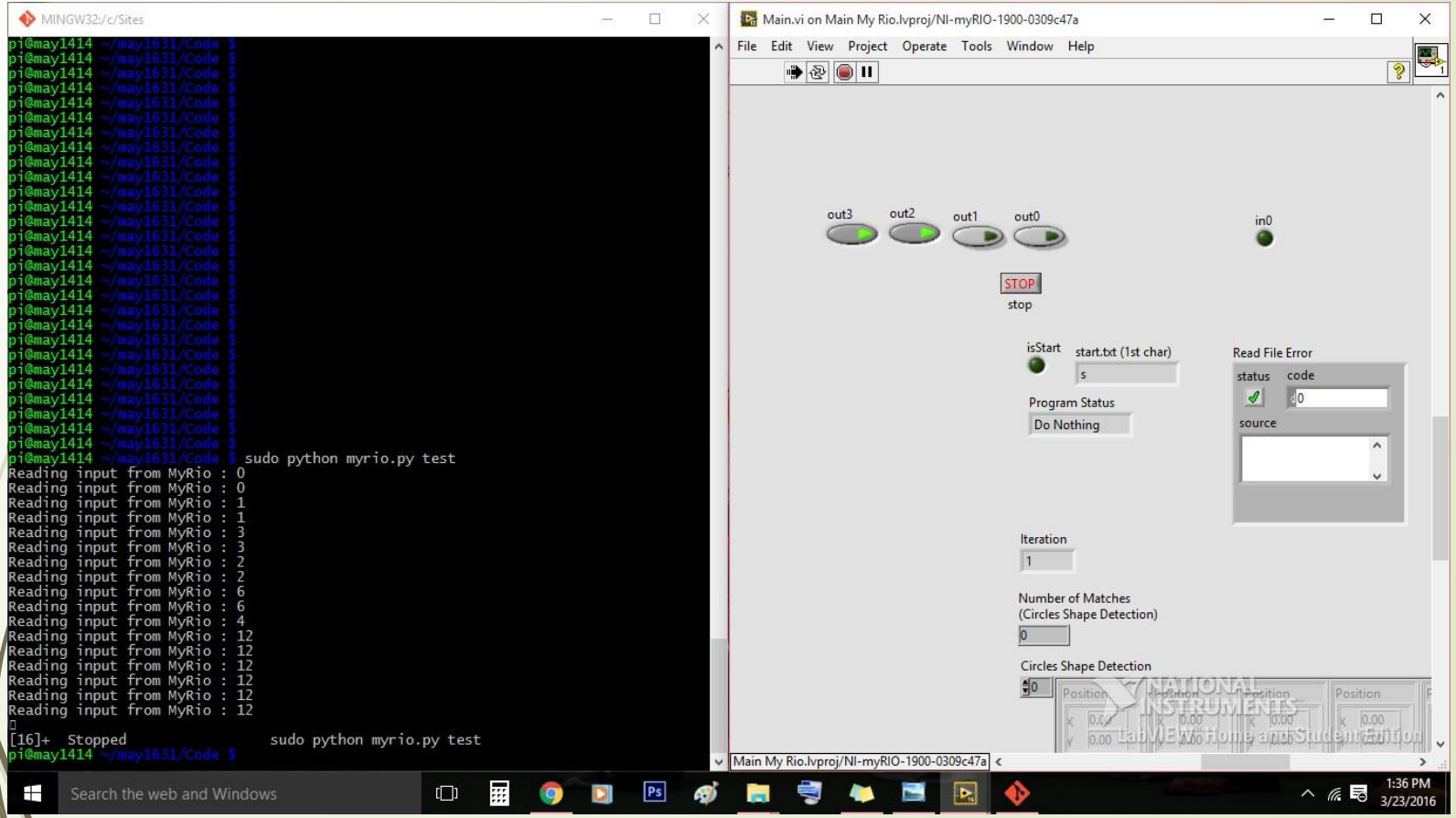
Communication between MPU and IPU

MCU		IPU
PIN 16	→	PIN 13
PIN 21	←	PIN 19
PIN 22	←	PIN 21
PIN 23	←	PIN 25
PIN 24	←	PIN 27

Through 5 Digital Pins

- **1 from MPU to IPU**
  - Signal the to start or stop the program
- **4 from IPU to MPU**
  - Send number of tools that are taken or returned from latest transaction

Communication between MPU and IPU (Testing)



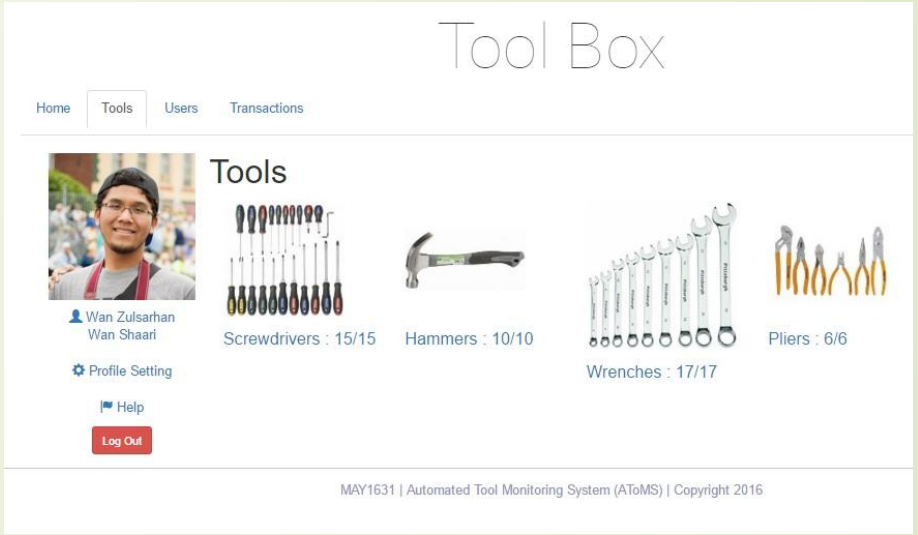
Web Application

Admin Privilege

- Monitor all user activities
- Giving or blocking user access
- See tools availability

Regular User

- See tools availability
- Request for access



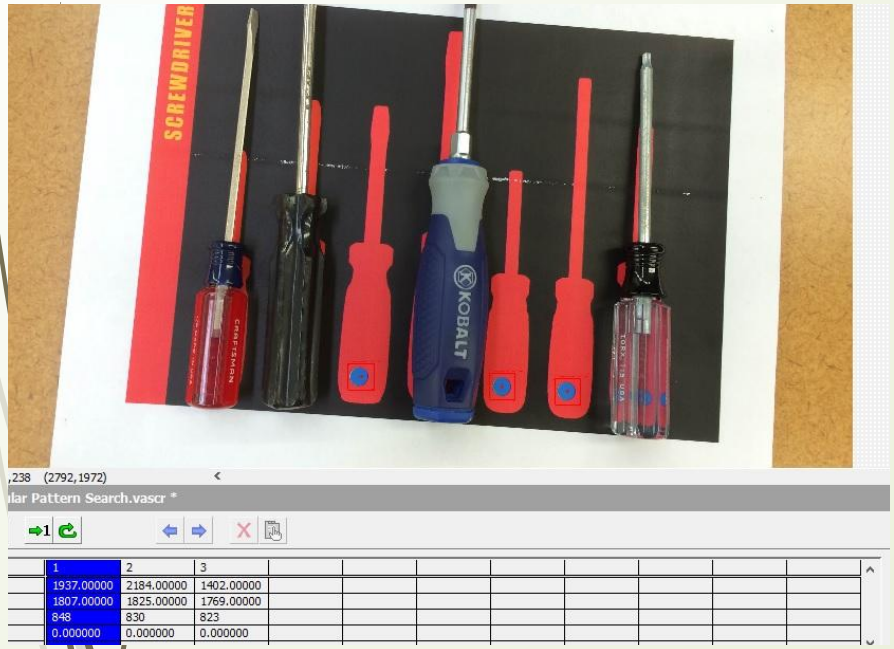
ToolBox

Tool Detection Design

Vision Assistant

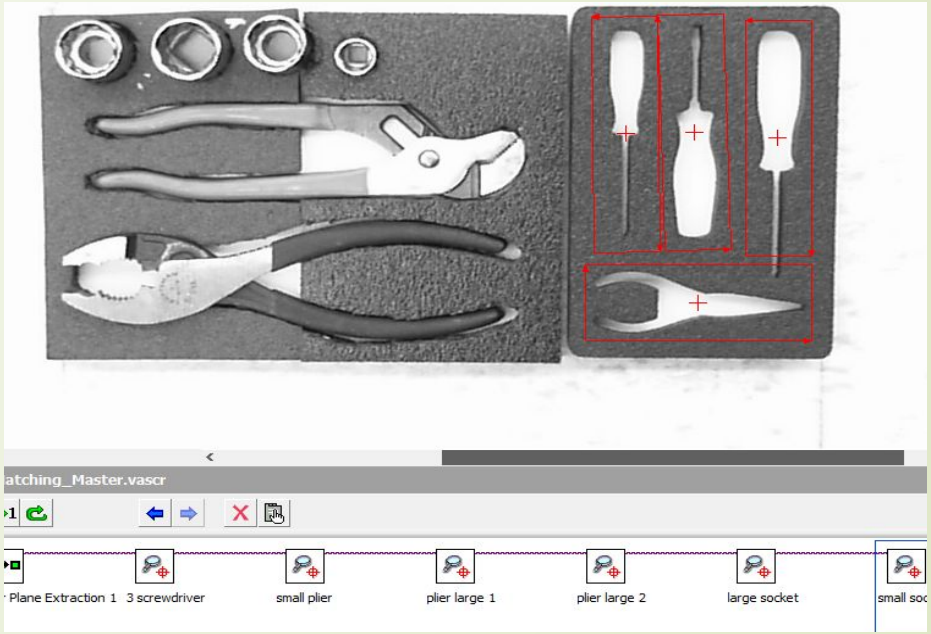
- Specialized in creating program for image processing and analysis
- Has a lot of in-built helper functions to analyze image

Previous Tool Detection Design



Using shape sticker and Circular Pattern Matching

Current Tool Detection Design



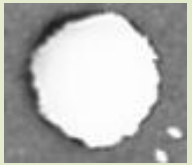
Using Pattern Matching

Pattern Matching Template

Large Plier

Small Plier

Screwdriver

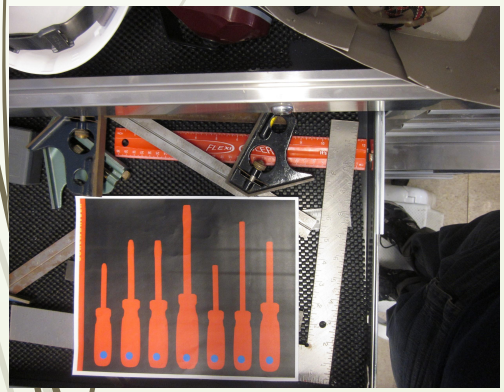


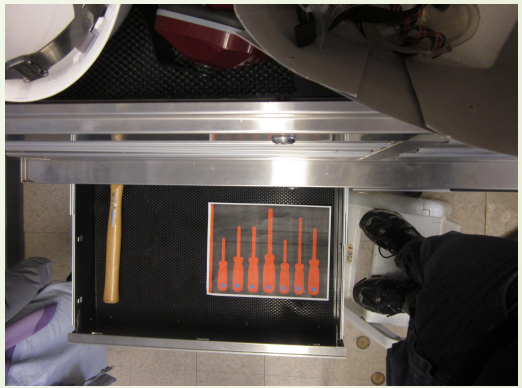
Socket

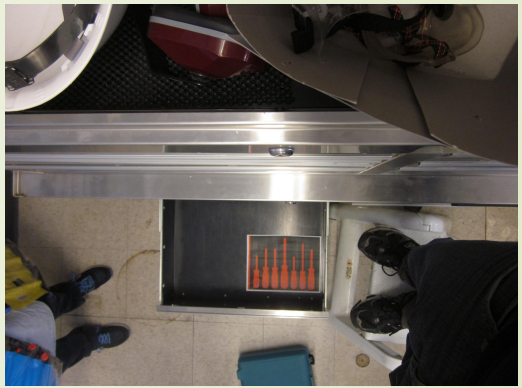
Testing Plan

Image Processing Unit (Vision Assistant and LabView):

Different distance drawer





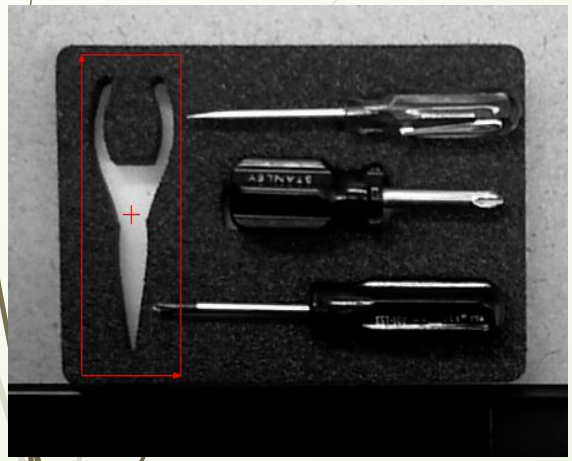


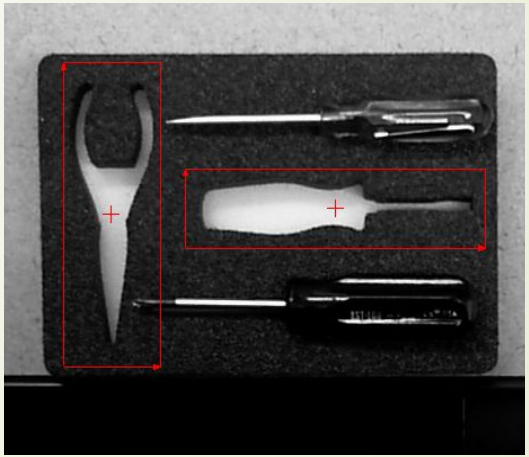
Testing Plan (Continued)

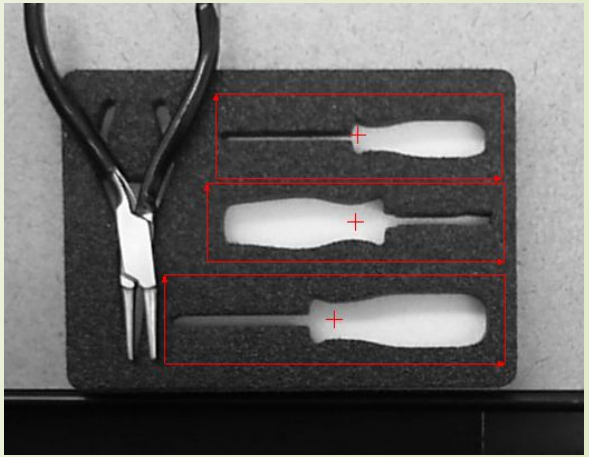
Different foam color

Testing Plan (Continued)

Different tools







Hardware

Divided into 3 major areas:

- Monitoring
- Locking mechanism
- Drawer detection

Monitoring

Includes:

- Card swiping authorizations
  - Read the identification number of the card swiped
  - Parse the identification number
  - Authorize the identification number with database
- Video surveillance & Image Capturing
  - Activate camera
  - Record video & take pictures
  - Upload video to Dropbox
  - Get a share link for the uploaded video

Locking Mechanism

Requirements:
Be able to create an independent locking system that could be integrated in the existing lock (using keys)

Limitations: Must have priority locking mechanism

- Existing locking mechanism using keys is the priority.
  - Reasons: there is probability for the system to be not operable.

Testing and design has been made and showed positive feedback.

Drawer Detection

Requirements:
Be able to detect 2 or more drawers being open at a same time.

Limitations: Number of drawers

- Existing system would support up to 28 drawers. (Existing toolbox has 26)

Testing and design has been made and improvement has been suggested to overcome the limitations.

Hardware Used

- Raspberry Pi
- NI MyRIO
- Yasoo®New 3 Magnetic Card Reader
- Camera Name(Microsoft webcam and Logitech webcam)
- Parallax Standard Servo (#900-00005)
- MC 38 Wired Door Window Sensor Magnetic Switch

Full System Test Plan

- Implement full system by assembling all software and hardware part of the systems
- Carry out full system testing:

  Swipe card/Manual log in

  Toolbox drawer unlocked

  Video and image captured simultaneously

  Take out a tool from drawer

  Tools detection processed and analyzed

  Swipe out

  Data recorded in database

  Videos uploaded in the Dropbox

Video Demo

Project Costs

Component	Price Per Unit ($)	Unit	Total ($)
Raspberry Pi	44.99	1	44.99
USB Hub	6.99	1	6.99
Magnetic Card Reader	14.45	1	14.45
Numpad Keyboard	10.99	1	10.99
Display Monitor + Audio	59.30	1	59.30
SD Card	7.95	1	7.95
Parallax Standard Servo	12.99	2	25.98
Reed Switch Magnetic Sensor	3.56	20	71.20
National Instrument MyRIO	250.00	1	250.00
Pro HD Webcam 1080P	29.99	1	29.99
Microsoft LifeCam Studio 1080p Webcam	99.95	1	99.95
TOTAL			**$621.79**

Plans for the Future

After the completion of our senior design project, one subject that we look forward to is the introduction of our system in other ISU Departments and tool cabinets

- MyRio and image detection templates allow expansion to other tool cabinets
- Tool templates may be uniquely modelled for each tool
- Provides method of organization and accountability

Conclusion

- Improvements have been made to the Tool Detection Systems
- System is designed to allow expansion to other tool cabinets
- All systems are separately assembled and functional
- AToMS may be implemented by other Colleges within ISU

Thank You!

Any Questions?

Project Timeline