DEVELOPMENT OF MONEY COUNTING MACHINE BY ARM BASED MICROCONTROLLER

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Abstract - The money counting machine (MCM) is one of the miracles of the science. Different techniques have been used to design and improve the counter machine, range from the simple counter that counts a number of notes with normal speed to high-level counter that utilized image processing to detect the type of currency and its amount in addition to used multiple fake detections and can run in very fast speed. These techniques and devices are highly expensive so just used in some area like banks, exchange office, markets merchant, etc. However, nowadays there is an improvement in design microcontroller unit (MCU) and its application along with it become in low cost, so there is a need to design counter machine based on utilized MCU and sensors. This work aimed to design a low-cost counter machine with fake detection that utilized MCU based ARM Cortex-M4 32 bit. The Teensy MCU version (3.2) as prototype card has been used which has ARM Cortex 32 processor. The mechanical parts that consist of the roller which has rods in a continuous pattern and the roller move these rods with a particular fixed speed. Laser transmitters and receivers have been used to detect notes and start and stop counting in addition to counting each note. The UV sensor has been used as fake notes detector. The counting result has been shown in LCD screen and the system will stop counting if detect any fake note. The results appear a relatively high-speed counting with high accuracy (100%) in counting and fake detection.

Keywords - Currency counter, Teensy3.2 microcontroller, Notes counter, UV detector, Cash validation, ARM Cortex M4, Fake Note Detection.

I. INTRODUCTION

A money counting machine is a machine that that counts cash either piles of banknotes or loose collections of notes. Note-checking machine not only counts, they also function as a high-speed counterfeit banknote detector, that helps to detect counterfeited money in the face of the advanced Forgery techniques by printing, copying, and electronic scanning technologies [1].The first ever recorded money counting machine was invented in 1958 in China, made by a small-time banker Zhi Tian Sie, who participated it in a challenge. He won third place. Zhi died at the age of 30 years old and his model was lost until recently rediscovered when tearing down his home [1]. Various set of counting machines such as Basic Note Counter, Intelligent Counting cum Counterfeit detection Machines, and Hi-Speed Heavy Duty Cash counting machine are available to suit different type of customers. Highly dependable and ideal for Banks, Big & small business houses, Traders, retailers, jewelers and almost all types of business establishment can use them according to their suitability [2]. With the development of sophisticated printing methods fake currencies have become on par with the original currency. The need to validate currency authenticity has increased dramatically, increasing the demand for continuous improvement of counterfeit detection technologies. One of the earliest processes was to use Ultraviolet (UV) detection. It is based on the principle of detection of special kinds of inks that are only visible under Ultraviolet (UV) light. Since this method is low, the auto motion is introduced using NI-IMAQ. The polarization is depending on the principle that, the currency is not made of paper, but is a blend of cotton, paper, and linen. Moreover, the tree bark from which the currency is made is known as the Balsam figure which also contains a huge percentage of cellulose. Cotton is the purest form of cellulose. Thus, it is safe to say that Cellulose contains a considerable component of the currency. Although the other ingredients will have some cause on the polarization angle, the polarization angle of the currency is almost close to that of cellulose, and the angle obtained by passing laser through the currency is unique thus it is made use of validation of the original currency from the forged ones [3].

II. RELATED WORKS

Anju et al. (2016) [4] proposed counting machine uses the embedded system Arduino for the functioning of the machine, it utilizes a sensing technology to sense the count entered and sends the corresponding signals to the input stations of the IC in the Arduino board. The usage of Arduino board makes the machine more precise in functioning. The Arduino board on receiving the signals sends signals to input pins of a display which shows the number of the papers counted. The usage of Arduino makes the interfacing of the display and programming of the proposed project more favourable. The desirable count of papers can be counted out from a bundle by inputting the number. The automatic paper counting machine finds a plentiful application in many fields and proposed as a remedial measure for the problem raised in the exam cell of the college (on counting papers like a question and answer sheets) which was displayed as a publication within the campus on

various notice boards welcoming remedial measures. Shaikh et al. (2016) [3], describes an efficient automatic framework for detecting fake money notes. Also, it symbolizes a classification framework for linking original notes to their source printing presses. Experimental results the detection and classification frameworks have a number of accuracies.

III. BACKGROUND THEORY

3.1 Money Counting Theory

Money counting machine works on the precept of the breadth of the money pack. A cylinder which has rods in a continuous way and the cylinder move these rods with a specific speed. The speed stays stable as like in the ATM machine Counting machine has cylinder move on the pack of the money and there is a transducer to shift out the single money one by one at a stable speed which finds out that how much singular money has passed out in front of it [2].

3.2 counterfeited money Detection Theory

Varied-Density Watermarks, Ultraviolet Fluorescence, Intaglio Printing, Micro text, Holograms and Kin grams and Isocheck /Isogram, Fibre -Based Certificates of Authenticity

IV. PROPOSED SYSTEM SETTING

The counter has been designed to count notes in addition to detect fake notes. The whole system is controlled by the microcontroller (type Teensy) which is based ARM processor. The currency counting machine works on the principle on the pack of the bundle of money and there is a roller which has penises in a continual pattern and the roller moves these rods with a particular speed and these rollers moves on the bunch of money and just move out the single money one by one at a steady and high speed and there is a transducer which detects that how many single currencies has passed out in front of it. For fake detection, it is based on used UV detection. This based on that the fake currency that created by color copier or printer will produce an image that rests on the surface of paper which can easily be seen when UV light is placed over it. Real notes are printed on the optical fiber. In addition, the paper of fake ones is made from thicker paper than the real one. Figure 1 illustrated the proposed counter structure.

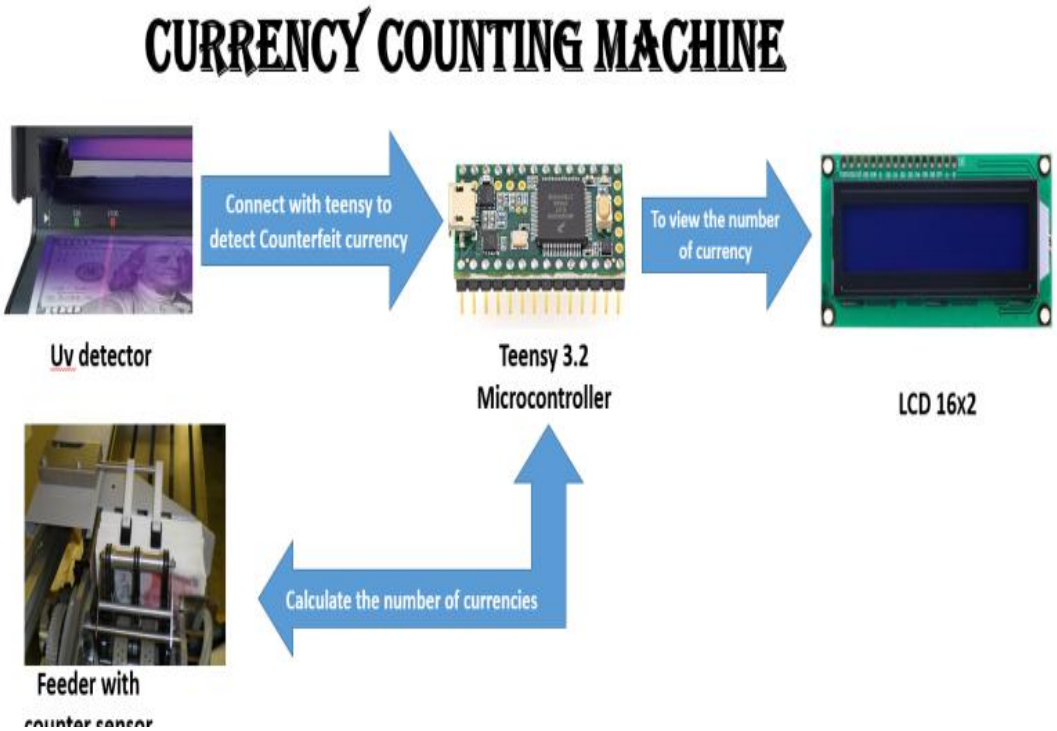


Figure 1: Proposed system structure

4.1 Hardware Structure:

The proposed system includes flowing parts:

1. Microcontroller: the microcontroller is responsible on control all operation. Teensy 3.2 microcontroller has 32-bit ARM processor which is used in order to manage overall process

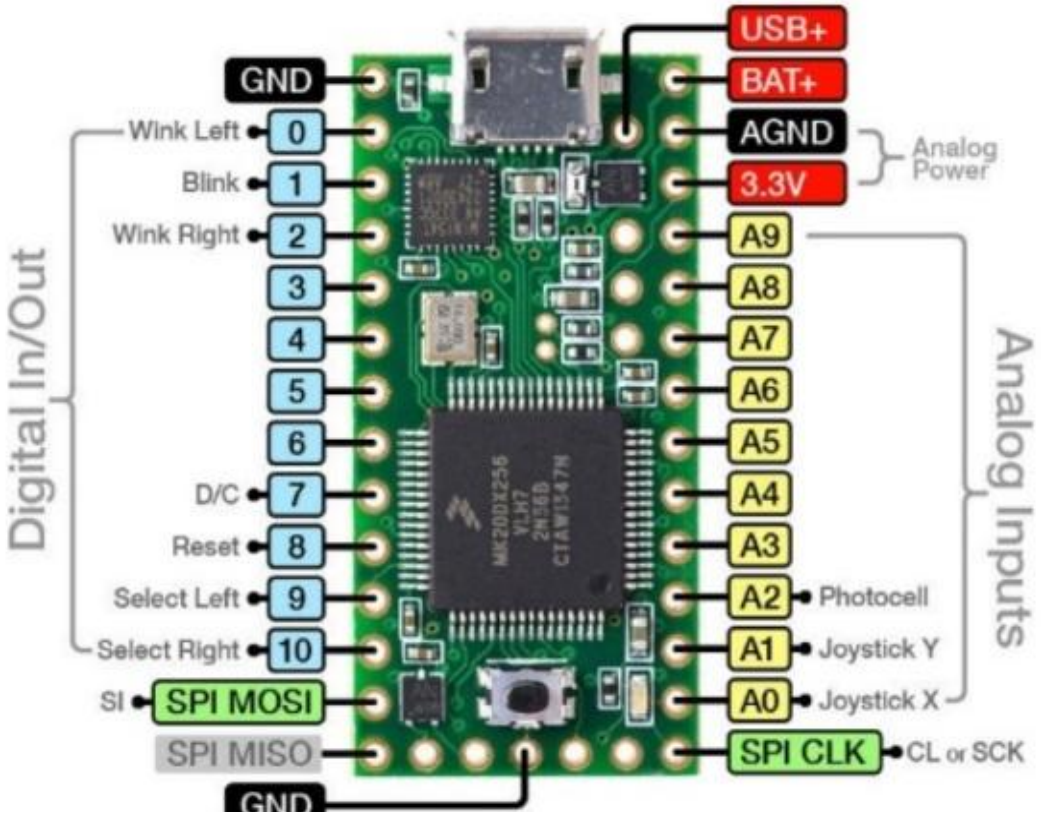


Figure 2: Teensy 3.2 microcontroller

2. Counter Circuit: this circuit is user interface that is used to control operation and see results. It consists of digital screen, push button, resistors and (IC CD4033).

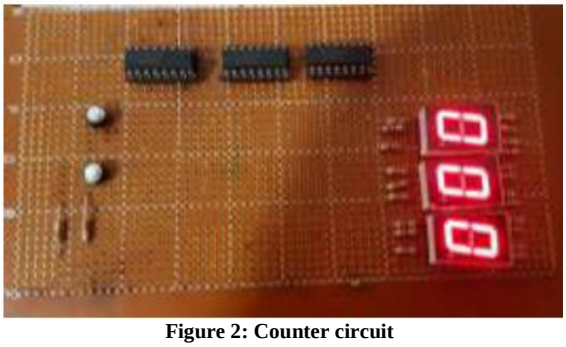


Figure 2: Counter circuit

3. AC motors: the system has a AC motors that is used to rotate money roller



Figure 4: AC Motor with switch controller

4. Mechanical parts: roller which has rods in a continuous pattern, where the roller moves these rods with a particular fixed speed.



Figure 5: Counter roller and rods

5. Optical sensor: this sensor detects each note pass through it and returns the signal to the microcontroller.



Figure 6: Left, optical transmitter, right optical receiver arranged with roller

6. UV source and detector: the UV has been used to detect fake notes



Figure 7: UV fake money circuit

4.2 Counter Algorithm:

The counter algorithm has been designed by used C++, and integrated development environment (IDE) is utilized to uploading program into MCU the flow chart is shown in Figure 8.

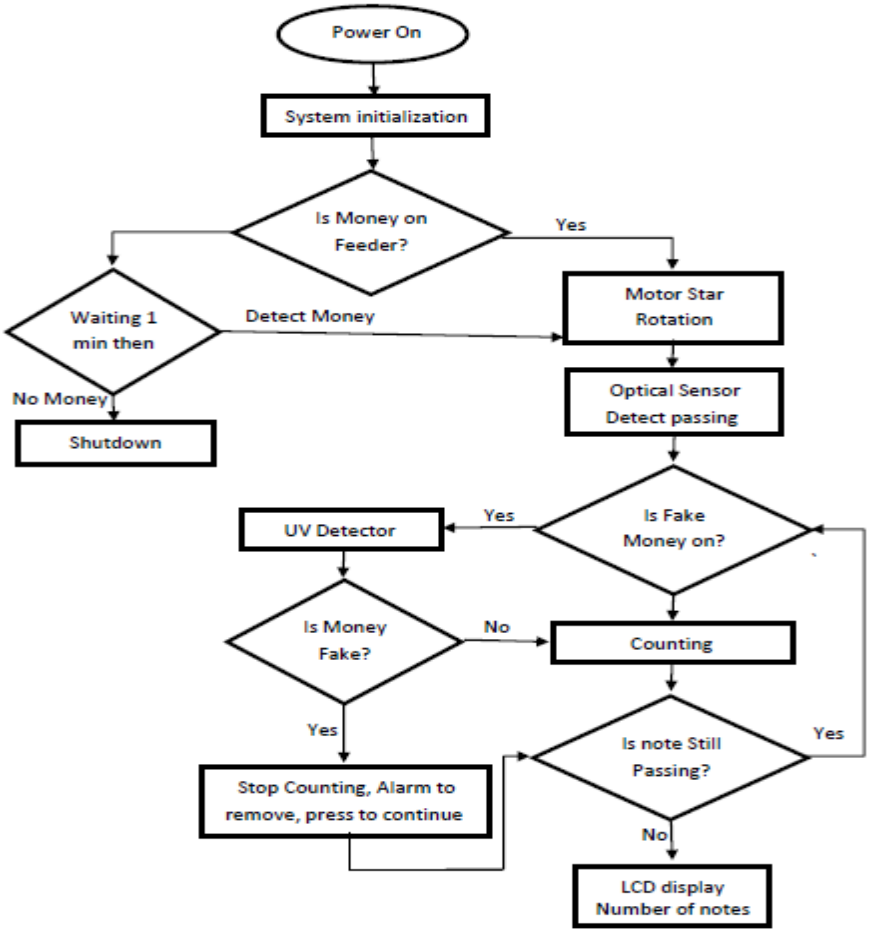


Figure 8: Note Counter and Fake detection algorithm

V. RESULTS

The system has been tested to count real note. 100 notes of Turkish liras (class 100) in addition to 10 fake Turkish liras have been used to evaluate the performance of the proposed system. At first, the 100 notes has been put on entry area and above note detection sensor, the system has started and the notes enter roller one after one and the counter success to count 100 notes and show it on screen as shown in figure 7.

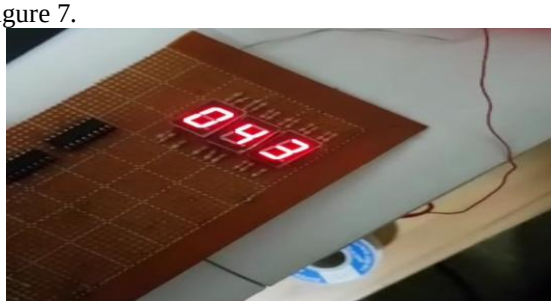


Figure 7: Counter Screen through counting process

In the second part, we removed 10 real notes from cash pile and put the 10 fake notes randomly that was identical in size and shape from real one inside that pile. The counter starts and stops when it detects a fake one until removing it and press start button and continue counting. The results show that the proposed system has detected all fake money and counting the real notes with without errors.

CONCLUSION

This study is aimed to develop money counter with low cost and adopted in the design on a microcontroller (Teensy 3.2 based on ARM-Cortex M4 processor) and ultra-violet (UV) sensor utilized to detect the counterfeit currency and the results showed This device was doing the counting process quickly, efficiently 100 %, accuracy and detect all counterfeited money. This study can be used to design low-cost counters.

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