

# Microcontroller Based Money Card Sorter with Pre-online Application Feature



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**Abstract:** This research is on the development of a microcontroller-based sorter of Money Cards together with an online application for the Money Cards as well. The sorter has 8 divisions in order to simulate the 8 areas in Metro Manila to where the cards will be sent to. The 8 areas are composed of the 7 areas in the South Metro Manila and 1 area composing of all the areas belonging to the North metro Manila. The website of the online application contains the necessary fields for the application of the Money Card. The sorter has a barcode reader. Each card has a barcode sticker corresponding to one of the 8 areas of the sorter. In addition, this barcode sticker corresponds to the information based on the online application where the cards will be sent that is specified by the user. The barcode reads the sticker on the cards and then sorts it accordingly to the correct corresponding divisions of the sorter.

**Index Terms:** Barcode, microcontroller, Money Card, Sorter

## I. INTRODUCTION

Life has been made easier by online applications. Most people prefer to send their information over the Internet [1]. This is just one of the proofs that technology now plays a big part in people's lives [2]. Being the only reloadable electronic cash card that works with mobile phones at present, The system has been serving their customers for years [3]. It can be used in any partner bank ATMs nationwide [4]. The process of applying for a Money card starts at the filing of application forms to any Wireless Centers [5]. All the approved applications filed by customers are being brought to the main office. This is where the cards are printed and sorted. All of these were made manually by the employees of Telecommunications [6]. This process is usually made for a minimum of one month before it is delivered to customers [7].

By doing the pre-online application, there is no need for customers to fill-out forms in their desired Wireless Centers and wait for long lines before their information is encoded in the computer. RFID can be used in the cards for improvement [8]. All they need to do is go to the website, take note of their reference number and go to the nearest Wireless Center to present their Identification Cards [9]. For automated card

sorting, the employees will be relieved of the burden of sorting the cards manually. Operational costs would also be decreased since it will not consume too much manpower to do the job. Human errors like a typographical error when encoding and updating the cards would be lessened. For the database optimization the Rough Set Theory can be used. It can pattern the studies of [10,11]. For the algorithm it can pattern the studies of [12,13,14].

This project will give customers the freedom to apply online for their Money Card application and the cards will be sorted automatically for customers to receive their cards at their address. Customers will fill out an online application. Based on the information, which is the address, given by the customer through the website, the sorter will send the cards to the appropriate postal office. Each area in Metro Manila has its own postal office. It is through these postal offices the cards will be sent to.

The appropriate postal office will be translated into a barcode [15]. The barcode scanner will decode the barcode and pass that information to the microcontroller [16]. The microcontroller will control the passage of the cards. The passages represent the different postal offices in South Metro Manila.

## II. REFERENCES AND METHODOLOGY

### A. References and Citations

The sorting brush decides which column will be sorted per cycle. Then, the selector switches identify which row per column would be included in the sort. In order to completely sort a deck, it requires a number of cycles. Some sorter models like the Type 75, 50 and 82 have a control panel or a plugboard which allows the multiple column selection devices. The sorter invented by James Albrecht sorts a deck of cards according to rank and suit and even on the kind of deck the cards will be used for. A read head is used to read the rank and suit of each card. A controller is used that reads the information of each card and then controls the sorting of the cards. The method for sorting is placing the cards on a holding tray. A series of slots are also provided for the red card to be placed into one of the slots. What it does is that after a read-head reads the card and then processes what suit and rank it is, the holding tray is then moved to the appropriate slot. After which, the card is released to that slot. The manner of sorting depends on what setting the user input. It can be a sort of new cards, a sort for poker cards and etc. The controller is programmed to have a sort of cards for new cards meaning it is sorted by rank and suit. It is also programmed to sort for poker deck and other games as well.

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There is also an option for user-defined input for the type of sort the user wants. For the invention of Hasuo and his other colleagues, the type of card sorter they created held the definite number of stackers. The concern of the card sorter was that to sort the cards effectively and therefore reducing the number of times the cards are moved so the cards will not be damaged.

There are two stackers to store the cards after being sorted, a reading sensor to read the information on the cards, a card rack to hold the cards that are to be sorted, and memory to store information from the card stackers. To improve the efficiency of the system Neural Network can be used just like in the studies of [17,18]

The method of sorting the cards is the cards are read by the reading sensor. After which the card is transferred to the card stack by means of rollers. The information is then fed to the memory. The memory stores the information [19, 20,21]. Cards are extracted from the holding rack and sorted simultaneously. Cards are passed from the two stackers until the memory finally determines the cards are already in order. Since the memory is connected to one of the card stackers therefore, the memory has the information on what cards are in the stack and how the cards are arranged [22,23]. The cards are read and then compared from the stackers until all the cards are sorted and have satisfied the condition of the program in the memory. The disadvantage of the invention is that if there are more cards to be sorted, the stackers had to be altered as well; resulting in modification of the apparatus to accommodate new stackers and larger stack or racks as well for holding the cards. For database communication USB can be used [24]

**B. Methodology**

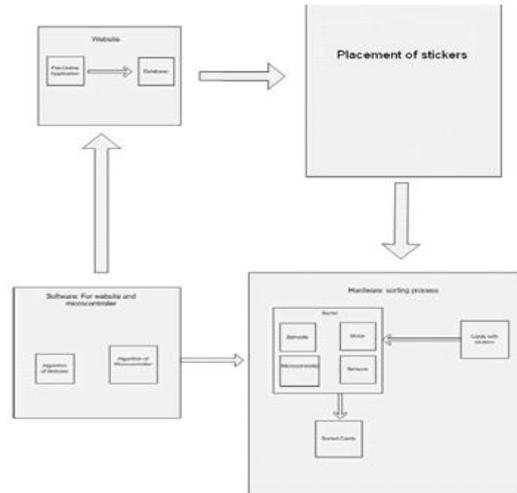
For our research, we intend to know more about the sorting process of the cards. After that has been determined, we will then try to plan how the process will be made more efficient when we make the process automatic. The group will intend to research past card sorters and research on how to make a prototype card sorter [25].

The group will also research on what kind of process the sorting would be. The sorting process to be determined would have to be efficient and can sort accurately.

In terms of cost, the group will look for materials that may be used for the prototype that is useful and not that high of a cost. Since the prototype would make use of a microcontroller, the group will look for a microcontroller suitable for the prototype. Spatial Imaging is also considered as an alternative process design [26]. It will be researched on how to utilize the microcontroller to control the whole sorting process. For the website, the group will research on how to make a website and employ the necessary techniques in order to create a database [27].

**III. DESIGN CONSIDERATIONS**

As seen in Fig. 1, the block diagram shows the overall sorting process. Software block comprises of the algorithm needed to make the website and the algorithm needed to program the microcontroller for the sorting process.



**Fig. 1: Block Diagram of the system process**

In order to create the whole sorting process, it begins with the application completed by the user. When the user specifies where the cards will be sent to. From that information, it will be translated into a barcode. The barcode information will be printed on stickers. It will be placed onto the cards, placement of stickers. The cards are then to be sorted. For the sorting process, the sorter is made up of the barcode reader, motors, sensors, and microcontroller.

The barcode reader reads the barcode information on the cards. Sends this information to the microcontroller. The microcontroller processes the signal and sends a command to the motor driver 1 to correctly place the sorter in the correct location. The sensors determine if the sorter is blocking it and then sends a signal to the microcontroller. If the barcode information and the corresponding sensor match, the microcontroller sends another signal to the motor driver 2. The motor driver 2 releases the card. It is connected to the pinch roller under the cards by a belt. If the card belongs to area 2 it has barcode information of 136. That value would be stored in the microcontroller as integer x. And then when the next card is scanned, that card would have the barcode information stored to integer y.

If the value of x is greater than y, the sorter would move in a counterclockwise manner. If the value of y is greater than x, the sorter would move in a clockwise manner. This is done in order for the cards to be sorted efficiently. From the example, we have area 2 as 136 and the value is stored in integer x. If the next card to be read has a value of 137, the sorter would move clockwise. If the next card has a value of 135, the sorter would move counterclockwise. With this type of process, the sorter can move in both directions.

The design of the prototype was circular because it would be costly to use a conveyor belt system of design. The circular manner allows the ease of sorting since it would just rotate to a specified location. Also, the locations for the cards are large enough to accommodate the cards when it leaves the chute.

Table I: Speed of sorting

Batch	Speed of sorting in seconds (s)
1	4s
2	5s
3	4.5s
4	4.5s
5	6s
6	5s
7	4.8s
8	5.1s
9	5s
10	4.5s
11	4s
12	4s
13	5.5s
14	5.7s
15	4s
16	5.8s
17	4.1s
18	5.2s
19	4.9s
20	5.5s
21	5.3s
22	5s
23	4.3s
24	4.4s
25	5s
26	6s
27	4s

For the eject chute itself, a pinch roller is placed near the opening. The pinch roller is connected to the motor driver 2 responsible for releasing the card. It is connected by a belt. Therefore, when a signal is sent to the motor driver 2 to operate; the motor runs. The pinch roller will roll allowing the cards to be released from the chute. Relay card was used to automate the barcode reader.

IV. DATA AND RESULTS

For the website, the mock database was created with 80 records. It corresponded to 10 records belonging to each of the areas in the South Metro Manila and 10 records for areas not belonging to the South Metro Manila. An admin page was also created. However, for the website pages of the online application and the admin page, the website response time took longer than 13 seconds. Database design is important for this research [29,30]

Table 1 shows the results of the sorting process. It is per batch, each batch having a set of three cards at the most. Cards

can be sorted to a maximum of 6 seconds per batch and a minimum of 4 seconds per batch. For the sorting of the cards, some cards were either jammed in the pinch roller or were not placed in the correct location, due to the fast speed of the motor. With this said, 12 out of 81 cards were either jammed or not placed in the correct location. That is around 14.8% of error.

V. CONCLUSION AND RECOMMENDATIONS

For the testing of the sorter, it was noticed that if the sorter runs at a faster speed, the torque will be much greater ending up that the sorter may not be in the right location. The speed of the motor was compensated due to the weight of the sorter. The speed should not be that fast considering the motor used has a sufficient amount of torque but it runs on a low speed. If the motor used was pushed to perform at a faster rate, the sorter will not stop at the designated location due to the torque. The motor used for the prototype is for simulation or testing purposes only and not for industrial use.

For the sorting of the cards, it can scan and sort efficiently if three cards were put at each sorting. If more cards were placed in the sorter, the cards would get jammed at the opening of sorter where the cards would exit. For the testing purposes, three cards were put into the sorter. It correctly placed the card to its corresponding location where it should be based from the barcode sticker on the card. However, due to the fast speed of the motor, some cards were not placed directly into its correct location. There were some instances that cards would get stuck by the pinch roller.

A website for the pre-online application was created also. It used SSL for website encryption. To avoid automated submission of the application, a captcha/word verification was made for each application. A reference number was also generated after each application. The group used Apache as the webs server and MySQL as the for the mock database. But the website response time took longer than 13 seconds based on the Certain software. A test server was used by the group to host the website. A factor that can be attributed to the slow speed is that the server used was not a commercial server like the ones used by the website of corporations or companies. The server used is for personal websites. The group had trouble automating the system. A relay card was used to automatically put on the barcode scanner so that the sorter would just sort automatically. However, the microcontroller was damaged. During the testing of the integration of the relay card to the system, the group had trouble locating the error as the machine would not sort. After much testing, the group determined the damage why the sorter would not run. The microcontroller, as mentioned, was damaged due to the integration of the relay card. Too much voltage went through the microcontroller so it ceased to function. So, the relay card was placed with a different power supply from the microcontroller, it was placed with the power supply of the motor driver. The sorter functioned well. It can sort to a maximum of six seconds per batch of three cards. It sorted efficiently and fast.



For recommendations on the prototype, a motor to be used should have a high torque that can run at a fast speed. The motor to be used should run at a set speed even if the weight of the sorter is pushing down on the motor. These recommendations should be done if this will be implemented for industry use as the speed of the sorting process will be an issue when this is used in the industry. Also, cards should not be jammed when leaving the stack. A good pinch roller or component should be used to aid in the leaving of the cards from the stack. Cards should not get stuck when leaving the stack of cards. The amount of locations for the sorter made is limited. For recommendations on the partitions, the number of locations can be increased. The different partitions can be replaced. Like, making a circular sorter similar to the prototype but increasing the number of partitions or locations. The server of the website should be a commercial server. This is in order to have a faster speed and be able to process information faster.

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